THE
PRACTICAL MAGAZINE

No. 3. VOL. 1, 1873.

SIR JOSIAH MASON.

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IN a country like our own there are always plenty of opportunities for men of capacity, industry, and enterprise to acquire wealth, and, if they choose, to achieve honours. The conditions of modern society, and the ever-varying development of commerce and manufactures, lend themselves with marked facility to the creation of this class. The merchant who has the sagacity to appreciate the promise of a new market for his wares, reaps a rich harvest as the reward of prescience and enterprise above those of his competitors. The manufacturer who successfully applies a scientific discovery, or who devises improved machinery, so as to lighten the cost and to expedite the speed of production, draws for the time into his own hands all the profits of a monopoly. Even the trader or producer who, content with humbler methods and smaller gains, is also content to practise thrift and to accumulate his earnings, may rise to the possession of wealth, and may thus accomplish the end so much desired by so many men, of leaving behind him a great fortune. Of self-made men of this kind there are abundant examples in the annals of British industry—enterprising merchants, skilled manufacturers, fortunate speculators, traders in all products of nature or of labour, venturers in all the markets of the world. But these, though they enrich and strengthen a nation, scarcely adorn or elevate it. Unlike the great inventors, the Watts, the Arkwrights, and the Stephensons, they fail to impress upon industry the glory and the power of science. Unlike the great organizers, the Salts, the Crossleys, and the Brasseys, they fall short of leaving marvellous examples of difficulties overcome and work accomplished on a colossal scale by the faculty of order and proportion of means to an end—the sign of industrial as of military generalship. Unlike, again, another class—the smallest of all, yet in some respects the highest—they fail to regard themselves as stewards rather than possessors of wealth. Content with riches for their own sake, or for the sake of what they bring, the common run of self-made men leave to the Peabodys and the Masons at once the praise, the glory, and the rich reward of raising their class to the rank of national benefactors, by the practice of rare self-denial, and the exercise of thoughtful, intelligent, enduring, and unexampled charity. For Sir Josiah Mason we may claim the distinction of belonging to all the classes above indicated. To use the common phrase, he is self-made, both in mental acquirements and in wealth; and with this he is an inventor of no mean rank; a great organizer and administrator; full of business resource and enterprise; capable of great undertakings, yet thrifty in personal habit and economical in the use of means; and, finally, most generous in the employment of wealth, and with munificence uniting a thoughtful purpose and a wise arrangement which double the value of his gifts. Many men bequeath large sums for others to apply. Sir Josiah Mason, in his life-time, dispenses a princely fortune, so ordered that he may himself work out his own plans for the benefit of his fellow-creatures. Presently, we shall explain the nature and extent of these benefactions, and the means adopted by the giver to make them enduring in their benefits. Before doing this, however, we have to sketch the personal history and the labours of the man himself.

We have spoken of Sir Josiah Mason as a self-made man. He deserves that honourable description in a special degree, for, although belonging to a respectable family, his parents were poor, he was early left with a widowed mother, and from the age of twelve years, he was under the necessity of making his own livelihood, in any calling that might be open to him. It will thus be seen that he had no advantages of early training in education: a boy who went to work at twelve years old, nearly seventy years ago, would have small chance of school teaching, for in those days schools for the poor were few and far between, and such as existed were not specially remarkable for excellence. Of his hardships and struggles in these early years, Sir Josiah Mason makes no secret; indeed, recounting to his friends the progress of a life of honourable industry, he tells them, with honest pride, that one of his earliest occupations was that of selling rolls, as a baker's boy, in the streets of Kidderminster, his native town. In the same spirit of manly independence, but not of ostentation—for there is no trace of this in his character—he gives a brief narrative of his life, in the opening recital of the deed of foundation of the Scientific College, which is to bear his name, and to absorb a large portion of his wealth. The following is a quotation from this document:—"In explanation of the object and intention of these presents, the said Josiah Mason desires it to be recorded that he was born at Kidderminster, in the county of Worcester, and that from his earliest youth he was engaged in earning his livelihood, first as a shoemaker, then as a baker, then as a carpet weaver at Kidderminster aforesaid, whence at the age of twenty years he came to Birmingham, where until the age of thirty years he was a jeweller and gilt-toy maker, and was then introduced into his present businesses of steel split-ring and key-ring making (which introduction was the foundation of all his subsequent worldly prosperity) by his good friend Samuel Harrison, the first inventor of steel split-rings, and that he, the said Josiah Mason, having succeeded to the said business of the said Samuel Harrison, added to it the manufacture of steel pens, both of which businesses he hath ever since continued. With the capital acquired in the said businesses he, the said Josiah Mason, afterwards entered into partnership with George Richards Elkington (now deceased) as electro-platers and gilders, under the firm of 'Elkington and Mason,' and then in the business of copper-smelting, under the firm of "Mason and Elkington.' And the said Josiah Mason hath dedicated a portion of the wealth so acquired by him in erecting and endowing at Erdington [near Birmingham] an Orphan Asylum for boys and girls; and being deeply convinced from his long and varied experience as aforesaid in different branches of manufacture, of the necessity for, and benefit of, thorough systematic scientific instruction, specially adapted to the practical, mechanical, and artistic requirements of the manufactures and industrial pursuits of the Midland districts, and particularly of the boroughs of Birmingham and Kidderminster, hath determined to devote a portion of his remaining property to the foundation of an institution wherein such systematic scientific education may be given; and in order to connect the said institution with Josiah Mason's Orphanage, and to commemorate his connection with Birmingham and Kidderminster, the said Josiah Mason hath determined to provide for such preference for certain of the pupils of the said Orphanage, and for persons born in the said boroughs of Birmingham and Kidderminster, as is hereinafter provided."

This brief and pleasant autobiographic sketch—plainer and honester than autobiographies usually are—sums up in one view the main incidents of Sir Josiah Mason's life, the sources of his wealth, and the noble uses to which part of it has already been put, and to which great part of the remainder is destined. It may serve as a guide or index to the fuller narrative we are about to present to our readers, and in putting it to this use, we may say, truthfully, that it fairly represents the man himself—a truthful portrait sketched by his own hand—exhibiting him as he is, resolute, self-reliant, persevering in industry, adding business to business, facing new and untried risks as readily as well-established trades, prospering in all, invariably keeping before him a great purpose of public worth, and always mindful, with honourable pride, that, under God's blessing, his prosperity is the work of his own hands. To this, on the authority of those who know him well, may be added that in a hearty and healthy old age—he is now nearly eighty—Sir Josiah Mason retains all the enthusiasm and activity of youth, both mental and physical. He will outstrip many a younger man while walking about his grounds at Erdington, amongst the plants and flowers for which he has tender love; and every day, and sometimes twice a day, he visits and inspects the Orphanage, which lies at some little distance from his house; its towers in full view from his windows. Not only is the subject of our memoir thus active in body, but he is as keen and shrewd, and far-seeing in business as if he were a man of fifty; while, in lightness of heart, cheerfulness of disposition, and direct simplicity of character and manners, he seems like a young man just entering upon life. To those who do not know him, it is difficult to realize this picture of an octogenarian whom, after a career of incessant activity, time has touched so lightly, a venerable, white-haired patriarch, whose genial smile and buoyant temperament make young men feel as if he were no older than themselves.

From to-day, however, we must go back for nearly eighty years, and trace the outlines of a life that is worthy of record and of imitation.

Josiah Mason was born at Kidderminster on the 23rd of February, 1795. As we have seen, from his own brief narrative, he was first employed as a shoemaker, then as a baker, and next as a carpet weaver—the staple trade of the place. Kidderminster, however, offered him no scope for his energies, and therefore, in early manhood, he left his native place, and came to Birmingham, the capital of the Midlands; and then, as now, the centre of a vast net-work of manufacturing industry, though then on a small scale as compared with its present magnificent development. Ten years after settling in Birmingham, Josiah Mason was employed in the jewellery and gilt-toy trade—the latter name being given to the manufacture of imitation jewellery and other light articles of personal ornament. In this business the young man received a cruel blow—one that would have permanently dispirited a less resolute and self-reliant temperament. He had made himself so useful in the trade, and had exhibited such remarkable powers of invention and organi-

zation, that his master, desirous of retaining him, promised to take him into partnership. The fulfilment of the promise was delayed, then evaded, and finally broken, at the instigation of the family, when the master lay upon what proved to be his death-bed. Instead of the promised partnership, Mason was offered a large salary as manager. His nature revolted at the deception which had been practised upon him, he refused the offer, and severed his connection instantly with the business. At the age of thirty, with just thirty shillings as his whole fortune, he now found himself without employment. Such a man, in such a town as Birmingham, had not long to wait. Indeed, as the event proved, he had not to wait at all, for the incident which seemed to destroy his prospects, really put him in the way of fortune—a path of prosperity which never afterwards deviated, was opened to him at once. He had scarcely left the jeweller's warehouse, still burning with indignation, and suffering from a keen sense of wrong, when an acquaintance met him in the street, and learned the story of the separation. "Go to Mr. Harrison," said his friend, "he wants just such a man as you. Go and see him." Mr. Samuel Harrison was a split-ring maker in Lancaster Street, Birmingham. Mason went straight to him and asked for employment. "You are not afraid of dirtying your fingers with work?" said Mr. Harrison. "Try me," was Mason's rejoinder. Mr. Harrison did try him, the trial resulted in a permanent engagement, this led to a life-long friendship of the closest kind, and when Mr. Harrison died, Mr. Mason succeeded to his business, which, after an interval of fifty years, he still carries on, upon the same premises in Lancaster Street, with some of the old tools and presses still on the premises, if not in actual use. Other memorials of Mr. Harrison are preserved, with reverent care, at Mr. Mason's house at Erdington, and at the Orphanage; and nothing affords greater pleasure to his friend than to recount anecdotes of his old master and associate. Mr. Harrison was, in many respects, a man deserving to be held in affectionate remembrance. He was remarkable for strong, keen sense, and for uprightness of life and dealing: one of the class of old Birmingham manufacturers who never broke their word, and never consciously turned out a piece of bad or dishonest workmanship. Happily, even amidst the rush and whirl of modern competition, and of hasting after riches, there are many such still left in Birmingham, let its detractors say what they will. Mr. Harrison was not only a manufacturer; he was a man of considerable scientific acquirements, and was an acquaintance of Baskerville, the printer, and a close friend and assistant of the famous Dr. Priestley, with whom he engaged in numerous experiments and researches in his laboratory at Sparkbrook, the last vestiges of which have just been pulled down to make room for new buildings. Amongst other things that Mr. Harrison made for Dr. Priestley was a steel-pen, with which the doctor wrote. It was rudely fashioned—as compared with modern pens—out of a piece of sheet-steel, formed into a tube, and then the lower part was filed away into the shape of a pen, the parts where the tube joined being left as the "split." Pens, however, were Mr. Harrison's amusement; the making of split-rings and key-rings was his trade, and in this—Mr. Mason helping him—he introduced many improvements, bringing the manufacture, indeed, to the state of perfection in which it still exists.

While looking with Mr. Harrison at the steel-pen the latter had made for Dr. Priestley, and regarding it as a curiosity of manufacture, Mr. Mason little thought that he was himself destined to become one of the largest, if not the largest, steel-pen makers in the world. Yet so it was, and this addition to his business came about seemingly by accident. In the year 1828 or 1829—he does not remember the precise date—Mr. Mason was walking up Bull Street, in Birmingham, when, looking into the shop window of Mr. Peart, a then well-known stationer, he saw a card of steel-pens marked 3*s.* 6*d.* each! [Infinitely better pens are now sold at 4*d.* per gross of twelve dozen.] "The novelty," said Mr. Mason, recounting the incident lately to a friend, "and thinking of Mr. Harrison's pen, induced me to go in. Mr. Peart was writing with one of the pens. He said 'it was a regular pin.' I instantly saw that I could improve upon it, and I bought the 'pin' for sixpence." On examining the pen, Mr. Mason made out the name of the maker to be "Perry, Red Lion Square, London." Going home, he made three pens, from which he selected the best, and sent it, by that night's post, to Mr. Perry. Two days afterwards Mr. Perry presented himself in Lancaster Street, to see the man who had made a better pen than his, to ascertain if he could make them in large quantities, and to conclude a bargain with him. The requisite assurances and proofs were given—indeed a talk with Mr. Mason was the most convincing proof that he could do whatever he undertook to do—and an arrangement was made between him and Mr. Perry for the manufacture of steel-pens. From this beginning Mr. Mason became one of the greatest steel-pen makers in the world. He soon invented machinery for stamping, slitting, grinding, and the other processes requisite, and from time to time, by his own skill and that of others employed by him, the machinery has been improved until it stands out perfect of its kind. It is curious that although Mr. Mason has been so largely engaged in this trade for more than forty years, his name is scarcely known as a pen-maker. The reason is that for many years the Messrs. Perry took all he made, and the pens were sold in their name, as the famous "Perryian" pen. When he began to make for other dealers Mr. Mason still kept his own name back, and stamped his pens with the names of customers—chiefly foreign houses—for whom they were produced.

Up to the period just described Mr. Mason had remained comparatively unknown, and this from choice, for he had always, and still has, a great aversion to come prominently before the public. A new association, however, was formed thirty years ago which, in course of time, gave his name a world-wide reputation, although he himself was still little known personally. By the year 1840 he had become wealthy—the result of steady industry and quiet accumulation—and he then sought for some way of investing part of his means in a new form of industry. In 1842 he became connected with the late Mr. G. R. Elkington, who was then endeavouring to give commercial value to the new system of electro-plating. Mr. Elkington had the scientific knowledge which enabled him to take out patents for the new process, but he needed capital to develope it. Mr. Mason had the capital, and, equally important, he possessed the insight which enabled him to foresee the capabilities of electro-plating, the courage to make a great experiment, and the patience to wait for returns which, slow in coming, were, he felt convinced, sure to come at last. So he entered into partnership with Mr. Elkington, and the now magnificent establishment in Newhall Street—much of it planned and arranged by Mr. Mason himself—began to rise; and the renowned firm of Elkington and Mason became known to the world. This, however, was an afterthought. Their first intention was to grant licenses for the new process, and not to enter upon the manufacture of electro-plated wares. Happily for Elkington and Mason the difficulties encountered in regard to the licenses compelled them to begin the manufacture. Nobody but those actually engaged in the trade believed that it could prove successful; and many of Mr. Mason's friends lamented his rashness in risking his capital, and implored him to withdraw from a hopeless venture. Looking back by the light of present experience these fears present themselves as objects of ridicule; but those who know the early difficulties of electro-plating will rate them far more seriously. Remembering what they had to encounter, it says much for Mr. Elkington's perseverance and skill, and Mr. Mason's indomitable resolution that they held firmly to their project, despite repeated failure and extreme discouragement. But they did hold firm, and success came at last; success abundant, splendid, increasing. Some day, when the history of electro-plating comes to be fully written, the world may know the difficulties, hindrances, anxieties, and losses of those who created this vast branch of industry; and when that history is written, the names of George Richards Elkington and Josiah Mason will stand out foremost and in intimate and honourable association.

A few years after he had joined Mr. Elkington in the electro-plating, Mr. Mason also joined him in another undertaking which also proved a source of great profit to both. This was a venture into the trade of copper-smelting by a new process. In 1850 Mr. Alexander Parkes, a most ingenious and accomplished chemist employed by Elkington and Mason (best known now as the inventor of Parkesine), took out a patent for effecting improvements in copper-smelting. Messrs. Elkington and Mason approved Mr. Parkes' plans, and engaged to carry them into effect. After some difficulty in finding a suitable place, they decided upon establishing works at Pembrey, in South Wales; and here, under the firm of Mason and Elkington, the copper-smelting was begun. Pembrey, then a little fishing village, rapidly grew into importance, and thanks to the copper-works, is now a flourishing town. It is notable, as indicating his future use of the wealth thus honourably acquired, that one of Mr. Mason's earliest projects at Pembrey was the foundation of a school for the workmen's children, and this he made, on his regular visits, the object of his own particular care. The school is still continued, under the superintendence of one of the firm of Elkington & Co., and gives education to about five hundred children. The partnership between Mr. Elkington and Mr. Mason, both in the electro-plate trade, and in the copper-works, continued for some years; up to the time, we believe, of Mr. Elkington's death, or just before that event. Finally, however, Mr. Mason desiring to contract his operations, the partnership was dissolved, and he retired from both undertakings, returning, in his later life, to the business which had engaged

his earliest regards, the split-ring trade, and that which soon followed it, the steel-pen making. These branches of business he still continues to prosecute at his extensive manufactory in Lancaster Street, Birmingham, and other places in the town; and even now, when close upon his eightieth year, he gives personal superintendence to undertakings which many younger men would shrink from controlling single-handed.

We have now brought to a close the account of the business life of Sir Josiah Mason. It is a record of untiring industry and of bold, far-seeing, and honourable enterprise, particularly in its relation to two of the great industries of the country—the manufacture of steel-pens, and the electro-plating trade. Sir Josiah Mason, as we have shown, ranks amongst the earliest and most original and successful promoters of the former industry; and, as to the latter, but for his courage in providing capital and business talent, in conjunction with the skill of his coadjutor Mr. Elkington, the trade might for a long time have languished under its difficulties, and would almost certainly have been lost to Birmingham, which is now the chief seat of it, and with which the name of the old firm of Elkington and Mason is inseparably connected. Of the public life of Sir Josiah Mason there is nothing to record, for he has never been a public man, having no relish for business of that character. Once only he stepped out of his retirement, and then it was to do a good action. After the disastrous failure of the Birmingham Banking Company, in 1866, it was considered advisable to mitigate the loss by founding a new company of the same name, which might assist in winding up the affairs of the ruined concern, and thus prevent further loss to the unfortunate shareholders. In order to give success to the project, Sir Josiah (then Mr.) Mason was urged to take part in it, and he consented, though with reluctance, to become chairman of the new company. This position he held until the bank was firmly established, and then he resigned it and returned to his congenial privacy. In 1869, again, his name came prominently before the public. On the completion of his Orphanage, in that year, the Town Council of Birmingham, with the general approval of the citizens, invited him to allow a portrait statue of himself to be erected in some public place, at the cost of the town; but, though at first assenting to the request, he afterwards withdrew his consent. Later still, when the magnificent foundation of the Orphanage was followed by the endowment of a Science College, Mr. Gladstone received Her Majesty's commands to offer Mr. Mason the honour of knighthood, and though careless of personal distinction, he obeyed Her Majesty's desire by accepting the offer; and thus, towards the close of life, Josiah Mason, the Kidderminster baker's boy, becomes Sir Josiah Mason, the capitalist whose wealth no man grudges, because of the noble use to which it is put; and the public benefactor whose name has come to be a household word wherever charity is valued, and education is prized as a chief blessing.

Closing here this personal record, we now pass to a brief notice of the manner in which Sir Josiah Mason has employed the wealth acquired in his long and arduous business life. First in order of time comes the foundation of the Orphanage.

For many years past Sir Josiah Mason has had a great love for children, especially for those rendered helpless by the death of their parents. We have seen this manifested by the foundation of a school in connection with the copper-works at Pembrey. It was more strikingly exhibited at his own place of residence, in the pleasant village of Erdington, near Birmingham. Some years ago he built at Erdington an institution designed to receive a number of aged women, and also a number of orphans. By degrees, as he thought them out, and watched the progress of this institution, his plans enlarged themselves, until at last he resolved to maintain the almshouses for forty-six women, and to erect in addition a magnificent range of buildings, capable of receiving about 300 orphans—admission being restricted to those deprived of both parents. The erection of the Orphanage was begun, in a quiet unostentatious way, about ten years ago, on a fine and healthy site of thirteen acres, at some distance from the almshouses, and lying well behind the village of Erdington. The design, a noble piece of architecture in the Lombardic style, was furnished by Mr. Botham, a well-known Birmingham architect, but, after a time, the founder himself undertook the superintendence of the work, and carried it on in his own way, and according to his own plans.

In August, 1869, the Orphanage was finished; and, in the manner habitual with Sir Josiah Mason, it was quietly opened without ceremony. An account published at the time, in the "Birmingham Daily Post" (Monday, August 2, 1869), gives detailed particulars of the building, and of the constitution of the Orphanage trust, from which the following leading facts are taken. The plan of the building is an irregular oblong, presenting a length of 207 feet in Bell Lane, the north-west or entrance front; 190 feet to the north-east or playground front; 300 feet to the east or garden side; and 270 feet to the west side, where the out-offices are placed. [A considerable addition, consisting of new dormitories, &c., has been made to the building since this account was published.] The gabled ends of the building project slightly, and each gable is crowned with a colossal figure of an angel standing with folded wings, as if watching over the peace of the children below. The long lines of roof are picturesquely broken by dormer windows, gabled, and of large size, to give light to the sleeping-rooms; and over the roofs three boldly designed towers rise to irregular heights. The principal tower, near the centre of the building, is 200 feet high, and is visible for many miles around. This tower has an enclosed centre, which is used as a shaft to carry off the heated air. Over the entrance is a tower, 120 feet high, covered with a high pitched roof; and a third tower, 110 feet high, serves as a chimney-shaft, into which all the smoke flues of the building discharge themselves, there being, otherwise, neither fire-place or chimney throughout the edifice, all the heating being done by hot-water pipes, and the cooking, washing, and drying, by steam. On the playground front is a massive rusticated arcade, forming a covered playground 174 feet long by 25 feet wide. The materials of the building are brick (three millions were used, all made on the Orphanage land), with stone dressings, mouldings, buttresses, and window frames. The cost of the building, as nearly as can be ascertained, was about £60,000; "for," says our authority, "Mr. Mason confesses that when the clerk of the works reported an expenditure of £50,000 he grew somewhat careless about keeping accounts, although a good deal of the interior work, all the furnishing, and the laying-out of the grounds, still remained to be done." The internal arrangements of the Orphanage correspond in their finish and completeness with the exterior. In the basement is an ample bake-house, and large ranges of cellaring. On the ground-floor are the main corridor, 155 feet long, and a second corridor, leading out of it, 121 feet long, both of suitable height and width, and well-lighted. These give access to the rooms for the staff of the institution; a dining-hall, 70 × 23; another dining-hall for infants; kitchen, 62 × 30; and other apartments. On the first-floor are school-rooms, play-rooms, lavatories (each child having separate washing places, towels, &c.), wardrobes, bath-rooms, and infirmary—this last capable of being entirely shut off, when in use, from the rest of the floor. The second-floor is appropriated to dormitories, each child having a separate bed; and the boys or girls being carefully shut off into their respective departments, under the care of attendants who are with them night and day.

The Orphanage is managed by a body of trustees, appointed by the founder so long as he lives, and after his death to be partly elected by the Town Council of Birmingham. All the children received are taught, fed, and clothed gratuitously, at the expense of the charity, and provision is made to place them in service or in trade on leaving the institution. The instruction given is a plain education in English, embracing all the branches usually taught in government elementary schools, with special training in household work for the girls. The religious teaching is confined by the trust-deed to instruction "in the Holy Scriptures in the authorized English version, and to the truths therein contained," and it is expressly provided, "that no catechisms, formularies, or articles of faith, whether of the United Church of England and Ireland, as by law established, or of any other body of professing Christians, shall be taught to the children." Divine worship is conducted on the same unsectarian principle. It should be added that as regards admissions, there is no restriction of sex, country, or creed. All who are in want are welcome; and how truly they are welcomed, and how tenderly cared for, may be gathered from the following passage, extracted from the journal above-mentioned as our authority for these particulars: "There is one point" (says the writer in the "Daily Post") "which the fullest description would fail to bring out. It is the tender thoughtfulness and the loving care manifested in all respects for the comfort and happiness of the children. If Mr. Mason had been contriving a house for children of his own he could not have studied the wants and habits of little ones more closely, or thought out each detail with greater pains than he has done for these poor orphans. Abundant evidences of this appeal to the visitor, however careless he may be. Not only may the provision of separate beds and washing-places be cited in proof of our remark, but there are also the arrangements of the bath-room, in which the physical comfort of the very little ones is especially studied, and the covered playground, with its triple columns, erected not for the requirements of strength, but with a particular eye to the children's favourite pastime of hide and seek. The same thoughtfulness is apparent in the flowers ranged along the main corridor, in the separate seats in the dining-hall, in the carefully sloped backs of the chapel benches, in the provision of musical instruments, and in many other things readily to be noted by those who love children and know their ways. Then, again, the little ones have their infantine toys, the bigger ones

amusements suited to maturer age, and for sturdy lads and lasses there are swings and gymnastic apparatus in the ample, open playground, looking out freshly into the fields. One thing more is too pleasant to be omitted—namely, that the founder knows all the children in the noble home he has provided, that he is known and loved by them, that the infants trot up to him, and put their tiny hands in his, that the elder ones brighten at his approach, that he has a kindly word and fatherly look for one and all, and last, but not least, that his own benevolent spirit seems to have passed into the minds of the attendants, from highest to lowest, making the whole place what its founder desires it to be—a home for those who are homeless; a family circle for those who have lost their natural protectors. May God bless such a work as this, and bless, too, the man who has done it!"

The other great work of Sir Josiah Mason's life, his Scientific College, exists as yet only in its design, and in the conveyance to trustees of a munificent endowment for it. The project of this institution was conceived in 1870, and much time was necessarily occupied in arranging the plan of the undertaking. Then the preparation of the deed of foundation, a matter of extreme difficulty, delayed the beginning of the work, and then the deed had to be registered twelve months before it could become operative—a necessary compliance with the Statutes of Mortmain. Within the last few months, however, considerable progress has been made, and the trustees under the deed have been appointed. Their first meeting will, probably, take place before these pages are laid before the public. In the meantime nothing has been lost by waiting, for, deeply interested in his favourite project, Sir Josiah Mason continually makes additions to the endowment of the College, so that when it is established, the new foundation will start with unexampled advantages—a well-devised scheme, and ample means to carry this into effect. A site for the College has been secured in the best position in Birmingham, immediately behind the Town Hall, close to the Corporation Free Libraries and the Midland Institute, and nearly adjoining the corporate buildings and law courts about to be erected. The intention of the College, as described in the quotation given at the commencement of this memoir, is to give to the young men of Birmingham and the neighbouring district, "thorough systematic scientific instruction, specially adapted to the practical, mechanical, and artistic requirements of the manufactures and industrial pursuits of the Midland district, and particularly of the boroughs of Birmingham and Kidderminster." The scheme of instruction, as defined in the 24th clause of the deed of foundation, is expressed in the following terms:—"As soon as possible after the completion of suitable buildings and erections in connection with the institution, proper arrangements shall be made by the trustees for the systematic instruction of the students by means of regular classes, and such other means as shall from time to time be deemed expedient, in all such subjects as shall be necessary to accomplish the purpose and intention of the Institution as heretofore declared. And the founder hereby expressly declares that such instruction *shall*, as far as practicable, include the following subjects, viz.: mathematics, abstract and applied; physics, both mathematical and experimental; chemistry, theoretical, practical and applied; the natural sciences, more especially geology and mineralogy, with their application to mines and metallurgy; botany and zoology, with special application to manufactures; and physiology, with special reference to the laws of health; and the English, French, and German languages; and *may*, in the discretion of the trustees, include all such other subjects of instruction as shall be necessary to carry into effect the intention of the founder to give thorough systematic scientific education and instruction specially adapted to the practical, mechanical, and artistic requirements for the time being of the manufactures and industrial pursuits of the Midland district, and of the boroughs of Birmingham and Kidderminster, and the surrounding districts, specially including mechanical drawing and architecture, but excluding mere literary education and instruction." Popular lectures on scientific subjects are also provided for, but it is declared to be fundamental that "no lectures, or teaching, or examination shall be permitted in the Institution upon theology, or any question or subject in its nature purely theological, or upon any question which for the time being shall be the subject of party political controversy." The general subjects of teaching may from time to time be varied by the trustees; and it is wisely directed that at certain specified periods the trustees shall revise the scheme of the College, for the purpose of adapting it to the requirements then existing. During the life of the founder the management of the College is to be vested in a body of six trustees, appointed by him; and after his death, five additional trustees are to be chosen by the Town Council of Birmingham; and this total number of eleven is not to be exceeded. All the trustees, it is provided, as a fundamental rule, must be laymen and Protestants; but no test whatever is imposed upon the principal, vice-principal, professors, teachers, or other officers; it being provided that no such persons "shall be required to make any declaration as to, or submit to any test whatever, of their religious or theological opinions, or be presumed to be qualified or disqualified by any such religious or theological opinions, but shall be appointed solely for their fitness to give the scientific or artistic instruction required from them."

We have now laid before the reader some account of the life of Sir Josiah Mason, and of the two great works to which (jointly) he has contributed probably not less than £350,000 of the wealth acquired by him in a lengthened course of enterprise and industry. Nobler works than these—of charity and education—could not have been conceived or executed, nor could money be put to more beneficial uses. The largeness of the schemes devised, the carefulness with which they are arranged, the marks of wise and liberal thought which characterize them, are alike honourable to the man to whom they are due, and in the highest degree beneficial to the community which, at his hands, has received gifts so admirable in character, so splendid in amount, and so full of benefit in the present and of promise for future generations.

THE SAFETY-VALVE AS A MEANS OF CONTROLLING STEAM PRESSURE.

ALMOST from the first adoption of steam as a motive power, its control and the regulation of its pressure, have received much attention from both scientific and practical men. Without means to measure the pressure and regulate the force of so powerful an agent, its use would be practically impossible. And even before steam was brought into anything like general use in mechanics, Papin employed the contrivance now generally known as the safety-valve for regulating the steam pressure in his "Digestor." According to first superficial notions, nothing could be more simple in arrangement or effectual in action than a conical piece of metal pressed against a corresponding piece secured to the boiler; the pressure of the steam gradually increasing till it exceeded the load on the valve would raise it and escape, securing thus, that the pressure could not exceed a given point. As steam-power came more extensively into use boilers were found to explode, some from one cause, some from another, and many boilers exploded without any apparent cause whatever.

Presently the steam-pressure gauge was invented, and this soon began to demonstrate that the so-called safety-valve was in many instances rather a snare and a deception than a protector, inasmuch as it did not do that which it ought to do. In a word, it is now well-known that after the valve begins to blow off freely the pressure of the steam advances to the extent of as much often as 30 per cent., and there are various known instances where, with a valve loaded to limit the boiler-pressure to 80 lbs. per square inch, the pressure has mounted to as much as 120 lbs., and this source of danger has lately attracted much attention in engineering circles.

Boiler explosions are such shocking calamities, they are so constantly the cause of death or of life-long injury to human beings, and involve such wholesale destruction of property, that any method to diminish the frequency of recurrence of such disasters deserves the most careful attention. It is not our purpose to deal with the question of boiler explosions in this article, but to confine ourselves to considering how far safety-valves serve to prevent them. No question of mechanical engineering detail is more beset with difficulty than this one, and it is somewhat unfortunate too, that it is one too much generalized on, as our American Cousins would say, and in discussions on safety-valve construction, the two points of, first, the innate defects of the valve itself, and secondly, the practice of tampering with its action that so largely prevails amongst the, in most cases, ignorant men who are employed as engine-tenters and firemen, are mixed up together. Before seeking to remedy what may be called compound evils, they must be separated, and each examined in itself; therefore, we believe, that in considering the safety-valve as a security against boiler explosions, the construction of the valve itself, the laws that govern its action, and the defects that exist in its present forms of construction, ought to be examined and dealt with, apart from the evils arising from tampering with its action on the part of those in charge. Any person taking the trouble to read the report of an inquest on the bodies of the victims of a boiler-explosion, will perceive that, as

matters stand now, there are no means of determining how far the disaster was due to inherent defects in the so-called safety-valves fitted to the boiler. It is perfectly true, that Professor Rankine has given certain, perhaps we ought rather designate them uncertain, data as a guide, but these data merely define the area of valve necessary for a certain-sized grate and given consumption of coal, in other words denoting that a valve must be of sufficient size to permit so many cubic feet of steam of a certain pressure to pass its faces. Now the intricacy of the laws that effect the flow of steam past valves of this class is well-known, and it is really well-nigh impossible to obtain a thoroughly reliable formula on which to calculate a valve area. As an example of this it is asserted by some authorities that the higher the pressure of steam the less the lift of the valve. In one sense it seems natural it should be so, as the greater the pressure the greater the velocity of the steam, and did safety-valve construction depend on this point only, the point could be dealt with on its merits, but there remains the chief point, that the safety-valve does not control steam-pressure; that the term safety is altogether a false one; and this point we now proceed to consider. Two sorts of loads are used for safety-valves, and each is applied in either of two ways; thus the load is either a weight or a spring, and this weight or spring is applied to the valve either through the medium of a lever, as in lever-valves, or else is attached directly above or below the valve, as in directly loaded valves. Taking first the lever-valve and weight, there is little room to doubt that for fixed boilers, such as Cornish, Lancashire and other classes of boilers, working always in one position, if properly constructed, this mode of applying the load to the valve is the best *per se;* we do not now refer at all to the question of tampering, we will come to it presently. What has brought odium on this form of valve is, that from its very simplicity it is constantly made as a trade article in the roughest and most ill-finished manner, and instead of being constructed on the principle of regarding it as what it really is, a most scientific contrivance, it is made, in hundreds of instances, with as little consideration of the scientific principles on which its effective action depends as if it were as destitute of such principles as a shovel.

It would be unsuitable to our columns to give any of the abstruse and unfortunately somewhat unreliable formulæ employed for calculating the proper proportion of diameter of valve to a given area of grate, suffice it to state a simple rule given by the late Professor Rankine, which is to multiply the quantity of water evaporated in lbs. by 0·006, which will give the area of the safety-valve. It is as well, however, to state that this rule is considered by some authorities to give an unnecessarily large valve. In order to convey to our readers a more exact idea of the action of a safety-valve with steam blowing off, we give the following figures, as stated in the course of a discussion of a paper treating on this subject, read before the Society of Engineers by Mr. T. Baldwin, in February, 1867.

TABLE.

No. of experiment.	Pressure in boiler above the atmosphere.	Weight on the valve in lbs. per square inch, where the valve lifted the undermentioned fractions of its diameter.				
		$\frac{1}{80}$	$\frac{4}{80}$	$\frac{8}{80}$	$\frac{12}{80}$	$\frac{16}{80}$
1	65	58	53½	52¼	51½	—
2	65	57¾	53¼	51⅓	—	—
3	73	58½	54	52⅜	—	—
4	65	53½	49½	48¾	48	—
5	67	59	48¼	—	—	—
6	70	61½	50	48⅜	—	—
7	65	56½	45½	—	—	—
8	65	55½	51	49	47½	46½
9	65	54⅛	52	50⅜	49½	—
10	65	57½	48	44½	—	—
11	65	58½	54½	—	—	—
12	67	56¼	52	49½	48½	47½
13	67	45	—	—	—	—

From the above table can be gathered a general idea, only a general one however, of the way in which the steam-pressure may go on increasing after the valve has begun to blow off, for suddenly diminishing the load a little on the valve is equivalent to raising the pressure beyond the load in like proportion; and examining the table in this way it shows that with a valve of a given area to a given proportionate evaporation, such a valve, loaded to 51½ lbs. per square inch, would run up the pressure in the boiler to as much as 65 lbs. before it would be lifted $\frac{12}{80}$ of its diameter, and, in experiment 4, a load of 48 lbs. would run the pressure up to 65 lbs. also. These experiments were made with a disc or perfectly flat valve. Experiment 12 was made with the common valve, the angle of face being 45° and its breadth $\frac{1}{8}$ of an inch; the pressure in this case equals 65 lbs. when the valve was loaded to 52 lbs. This will suffice to make clear to our readers the necessity that exists for securing a sufficient area of valve, and also the necessity for making the valve of a good shape, and this question of shape is one of the least accurately determined points of the whole question of safety-valves; in a general way it is admitted that the closing face should be as small as possible, but as to the sort of guide, whether a triple feather or a spindle and eye, or which gives the best results, little is absolutely known. We have stated above that an examination of the table shows the necessity for ample valve area, because, of course, if the valve be large enough the lift need not be great to provide sufficient space for the escape of the steam, but other and more abstruse points have to be considered; for example the now well-known law of induced currents steps in to complicate matters, and there can be little doubt that to the operation of this law is due much of the increase of pressure that is added on the steam-gauge after the valve is blowing freely. As many of our readers may not be familiar with this law we will explain it. If steam or air or any other gas is rushing along a tube with great velocity, a hole existing in the pipe at the time, air will be sucked into the pipe, and if a piece of paper, card-board, or other light substance is laid over the hole it will be drawn down on the pipe. This law is so well-known that in many instances advantage is taken of it to lubricate steam cylinders, an oil-cup and tap being screwed into the steam passage just at its opening into the cylinder, and the oil in the cup, when the tap is opened just as the steam first rushes into the cylinder, is sucked into the interior as effectually as if there were a vacuum in the passage. A familiar means of illustrating this law of induced currents is to procure a common tobacco-pipe, and to place on the bowl a piece of card-board a little larger than it is, pins may be stuck through it to keep it from slipping off sideways, all the power of the strongest pair of lungs exerted through the stem of the pipe is insufficient to blow away the card-board. The reason simply being that the air rushing out beneath creates a vacuum and the air above presses the paste-board down to the bowl. The steam with the safety-valve has exactly the same action on the valve as the air blown through the stem of the pipe has on the pasteboard.

Although a lever and weight when properly fitted appears the best plan of mounting a safety-valve, it is of course evident that such a plan is unsuited for locomotive or marine work. Safety-valves on marine boilers are always loaded with weights dropped on a rod or spindle with a collar on it. According to the Board of Trade rules spring-loaded safety-valves must not be used for marine boilers; and this is, we consider, a senseless rule, for when properly fitted, springs are infinitely better adapted for such work than weights; indeed, with pressures in marine boilers increasing each year, it will soon be practically impossible to employ weights directly on the valves, because they will require to be so great as to be altogether unmanageable; besides this, when a ship plunges down a sea-way, the inertia of the weight eases the valve, and lowers the steam-pressure; and when the vessel is rising, the reverse action takes place. Then again, as the ship heels over, so the load on the valve diminishes, while a side strain is put on the valve spindle, creating friction which destroys the proper action of the valve.

Having reviewed this question of safety-valve construction, we proceed to indicate the best mode of arranging a safety-valve of the lever class, whether loaded with a weight or a spring. The fulcrum of the lever ought always to be a knife-edge, as in a scale beam; the lever should have a stud projection about half-an-inch long—less than this if possible; indeed, the stud ought to project only sufficiently to prevent the lever touching the valve in any other point. This stud should be worked to a knife-edge running at right angles horizontally to the length of the lever. The valve should have a small hemispherical projection in its upper centre, on which the knife-edge of the lever would rest. This would effectually do away with any alteration of load on the valve as the lever lifted. The load ought also to be hung by a knife-edge. The fulcrum of the lever ought to be two knife-edges, one at either side of the lever, and they ought both to be of sufficient width, or rather length of edge, say $\frac{1}{8}$ of an inch for every inch of area of the valve, and they ought to form a T head of sufficient length to steady the lever from ever grinding against the guide that should be fitted as an additional security for the lever. All the knife-edges and their bearings ought to be hard steel. The question of induced currents and their influence on the efficient action of a safety-valve is one, unfortunately, too little known to enable us to consider it; both this question and that of the best shape for the valve, whether flat with conical seat, elliptical, or hemispherical in vertical section, are matters worthy of more careful investigation than they have yet received. Of course, if it is once

fairly demonstrated that induced currents of air really do seriously impair the action of a valve, then valves must be loaded and fitted in a way altogether different from the present practice. They should be so arranged that they would be lifted by the increase of steam-pressure at some point away from the valve itself altogether, the lever should be secured to the valve, and its outer end or ends raised by some such means as are used to rotate the index hand of the steam-gauge ; by this means, if properly adjusted to allow for the action of the induced currents of the atmosphere, then it would be impossible for the pressure to increase more than a couple of pounds per square inch. As an example of how this might be carried into effect, let a lever be supposed to stand across a safety-valve, and project, for a valve three inches diameter, twelve inches on either side of the centre ; let each extremity of this lever or bar be held down by a hollow helical spring,—or helical spring tube would be the fitter term—allow the steam in the boiler to have access to the two spring tubes. It is well-known that steam-pressure tends to straighten a bent tube ; therefore, as the pressure increased in the boiler, the strain of the springs would become less till a meeting-point arrived, when the valve would begin to blow off ; if the pressure still increased, then the load would become still less, and continue diminishing till the balance of power was reached. In this case the valve ought to be secured to and be lifted by the lever.

Of course, certain practical objections exist to the adoption of this scheme, such as the difficulty of accurately adjusting the spring tubes, and their great liability to become deranged in their action, owing to the differences of pressures and temperatures. More than one patent exists for so arranging the levers of safety-valves that the weight diminishes on the valve as the lever rises, by the change of distance in the centres of leverage ; but unfortunately the lift of the lever is too slight to enable this scheme to prove more than partially effectual, and the various parts must be most carefully made and adjusted to secure any beneficial action whatever.

As to the question of tampering, this is one that involves the exercise of care on the part of the steam user to employ none but trustworthy men, and to maintain a careful system of inspection. The plan of locking up safety-valves is at best but a rude contrivance, entailing quite as many dangers as it is supposed by its advocates to guard against. In a word, the whole question of the safety-valve, its action, theory and principles, ought first to be carefully investigated, and then we can know how to construct a good one.

H. W. PENDRED, C. E.

UNIVERSAL DRILLING MACHINE.

BRIEFLY, the difference between rivets, bolts, and nails, may be said to consist in the fact, that the first two require holes to be made for them, while the last make their own holes. The holes for rivets and bolts are made either by a punch or a drill. The preference is generally given in modern practice to the latter method ; but, without entering into this question, which, like many others, admits of pros and cons, there are undoubtedly some instances in which punching is to be preferred to drilling. All the various descriptions of drilling machines may be classed under one of two heads. The first of these comprises those machines which are stationary and fixed, and the second, those of a portable nature. Consequently in the one case, the object operated upon must move, and in the other remain fixed. The stationary machines are obviously the more simple, as their performance is limited to a movement of rotation, combined with a downward vertical motion of the drill point. So long as the objects to be drilled are of a convenient size, and capable of ready manipulation, the fixed machines answer the purpose. But when they become too massive, or too complicated in construction to admit of being moved with facility, recourse must be had to the portable drilling machines, which, in addition to possessing the two movements indispensable to those of a fixed character, must also be capable of being adjusted in at least two horizontal planes at right angles to one another. This adjustment, which is easily effected when the axes of the different holes are parallel, and when they are not too far apart, becomes more difficult to accomplish when other conditions obtain. If the holes in the same piece of iron have different directions, and the piece itself is of considerable size, the operation of drilling requires a machine especially constructed for the purpose. The machine, represented in the accompanying drawing in figs. 1, 2, and 3, is designed to overcome the difficulties which have been experienced in drilling holes under the above-mentioned conditions.

The drilling machine, which we are about to describe, was constructed by the well-known society John Cockerill, of Seraing, in Belgium, to be used in the workshops of that establishment. As an example of the work which the machine is accustomed to perform, may be mentioned the columns of the blowing engines built on the premises. These pillars are 27 feet 9 inches in length. They have a diameter at the base of 1 foot 9 inches, and at the top of 1 foot 1½ inch, and their weight is from 6,300 to 7,000 lbs. They have to be furnished with holes drilled in them, to receive the various brackets and other pieces attached to them. A longitudinal section of the drilling machine is represented in fig. 1, from which it appears that the shaft of the machine acts as an ordinary column to support the joists of the storey above. The shaft consists of a hollow cast-iron cylinder, 1, bolted down to a stone foundation and connected with the timber-work at top by a steel pin. Outside this cylinder is another, 2, which acts as a sheath or cover for the former. It rests upon steel balls, and can be moved round the interior cylinder by means of the tangent screw, W. The exterior cylinder carries an arm, 3, which can be adjusted vertically by the screw, W. This arm participates in the rotatory motion of the external cylinder, 2, to which it is connected by the vertical rod, C. It constitutes, in reality, a horizontal axis, capable of turning freely about a vertical one, at heights varying from 4·92 feet to 11·30 feet. A horizontal cylinder or cover, 4, is fixed to the arm, 3, exactly in the same manner in which the vertical cover, 2, is attached to the inner cylinder, 1. (See figs. 1 and 3.) This horizontal cylinder can only rotate about its axis, and motion in this direction is imparted to it by the tangent screw, W, which is mounted on the arm, 3, and gears into a toothed wheel fixed on the external cylinder, 4. The cylinder, 4, carries the two small brackets, 5, one at each end of the ring or belt, 6, which can be moved horizontally along it by the united action of the screw, V, and the pinion and wheels attached to the ring. The ring or belt, 6, goes round with the external cylinder, 4, to which it is attached, throughout its whole length, by a steel rod. The ring carries the bracket, 7, which supports the shaft, L, (see fig. 1), to which is connected the drill for boring the holes. The bracket can be caused to rotate by means of a screw and the wheel, 8, mounted upon the ring, 6, and gearing into a toothed wheel attached to the bracket. A balance weight, 6, (fig. 2), serves to maintain the whole arrangement in equilibrium. A progressive motion can also be imparted to the shaft, L, by the screw, V, and toothed gearing, U. From the above description, the movements of which the machine is capable, in addition to one of rotation, are, first, a movement of progression along its horizontal axis. Secondly, a movement of rotation about an axis perpendicular to the former axis. Thirdly, a movement of translation in the direction of its horizontal axis. Fourthly, a movement of rotation about the same axis. Fifthly, a movement of translation in the direction of the vertical axis. And sixthly, a movement of rotation about the same axis. A drilling machine which fulfils these conditions may be justly termed universal.

We have now to investigate the manner in which these different movements are communicated to the machine. The first shaft, A, in fig. 1, is carried on two journals, and is set in motion by an ordinary driving belt and pulleys, the former of which is connected with the general motive power of the workshop. The shaft, A, sets in motion, by means of a pinion, the bevelled wheel, B, which is in two pieces, and works loosely on the steel pin which connects the hollow shaft of the drilling machine with the timber joists above. The bevelled wheel, B, carries a spur wheel, which gears into another spur wheel, which is keyed on the vertical shaft, C, see fig. 1. This vertical shaft, C, is fixed on the exterior cylinder, 2, and can rotate with it around the internal cylinder, 1, without getting out of gear with the prime mover. Moreover it passes through the horizontal arm of the machine, in the interior of which it gives motion to a hollow rod, E, of cast-iron. The pinion, D, see fig. 1, is not keyed on to the shaft, C, but it carries in its boss a rod which slides in a groove made in the length of the shaft, and thus permits it to rise and descend at pleasure. Upon the hollow shaft, E, is keyed the wheel-work, F, see figs. 1 and 2, which by means of the wheel, H, sets in motion the horizontal shaft, I, which is held tightly in the two supports, 5, which are themselves fixed in the cylinder, 4. The shaft, I, can thus rotate with the cylinder, 4, without ceasing to be in gear with the rest of the machinery. The shaft, I, passes through the belt, 6, and communicates motion to the axis, K, by a couple of pinion wheels, J^1. The pinion, J, is not keyed upon the shaft, I, but carries a rod which slides in a groove made in the length of the shaft, so that the pinion can move horizontally without ceasing to rotate. The axis, K, passes through the bracket, 7, and, by means of the bevelled pinions, J^2, J^3, sets in motion the shaft, L, which carries at its lower extremity the drill. The pinion J^3, is not keyed on the shaft, L, but carries a cotter, which passes through a groove in it, in which it slides, so that

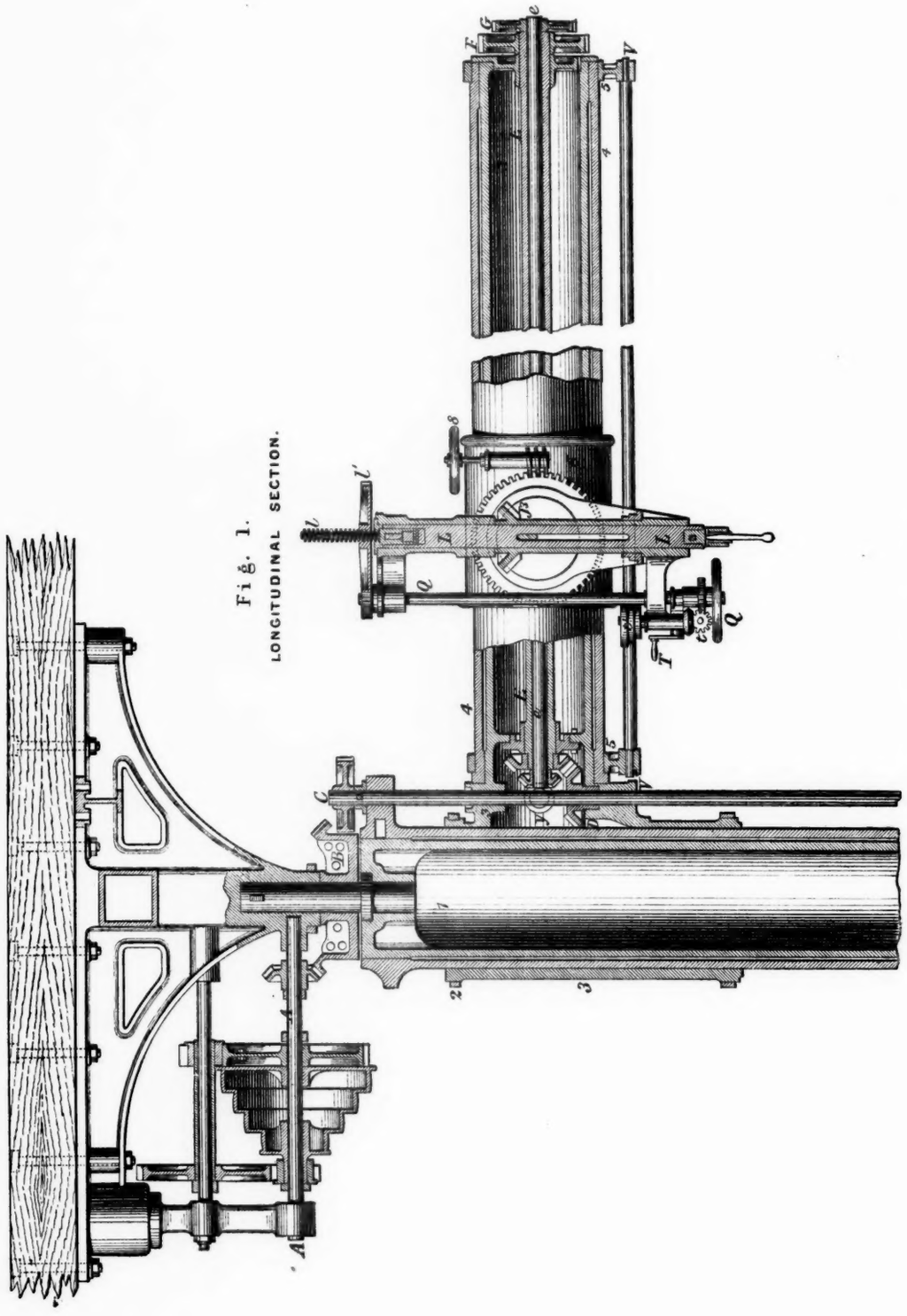


Fig. 1.
LONGITUDINAL SECTION.

UNIVERSAL DRILLING MACHINE.

the shaft, L, which carries the drill, can advance or recede in a horizontal direction without losing the rotatory motion it receives from the prime mover. During the boring of the hole it is clear that the drill must have a penetrative motion, or, in other words, follow it. This is accomplished by turning the screw, *l*, see fig. 1, which is directly connected with the shaft, L, by means of a small steel pivot. The screw, *l*, passes through the cog-wheel, *l'*, which acts as a nut to it, and is fastened to the bracket, 7. Motion is communicated to the wheel, *l'*, by the shaft, Q, the bearings of which are supported by the bracket, 7. By turning a small wheel keyed on to the shaft, Q, the drill can be raised or lowered at pleasure. But the upward or downward movement of the drill can be also performed in a self-acting manner. The small wheel keyed on the shaft, Q, is connected with the tangent screw, *t*, which, by the agency of a couple of bevelled pinions, receives motion from a small shaft, *t'*, driven by a belt and pulley. By moving the handle, T, see figs. 1 and 2, the tangent screw, T, can be put in, or thrown out of gear with the shaft, Q, and, consequently, with the screw, *b*, which regulates the movement of the drill. The rotatory movement of the external cylinder, 2, is produced by the wheel U, and the screw U^1, as already mentioned, but this movement may be obtained in another manner. The end of the screw U^1 is geared by two bevelled wheels to the vertical shaft, Z, carried by the external cylinder, 2. This shaft is again connected in a similar manner with the small horizontal shaft, Y, belonging to the arm, 3, and into which it penetrates until it reaches the solid shaft, *e*, which lies inside the hollow one, E (see fig. 2). The vertical shaft, Z, has a groove throughout its entire length, in which works a stud attached to the bevelled pinion gearing into the one keyed on to the shaft, Y, so that the connection between the shaft Z and Y is always maintained at whatever level the latter may be placed by the vertical motion of the arm, 3. The shaft, Y, is connected by levelled pinions with the horizontal shaft, *e*, which carries the wheel-work represented, by G, M, N, H, in figs. 2 and 3, so that motion can be imparted by *e*, to the shaft, *n*. Upon the latter, which is square in section, is mounted

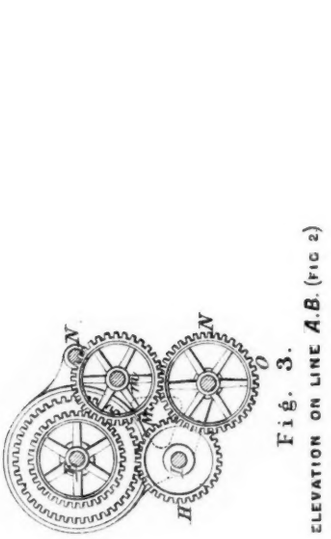


Fig. 3.
ELEVATION ON LINE *A.B.* (FIG 2)

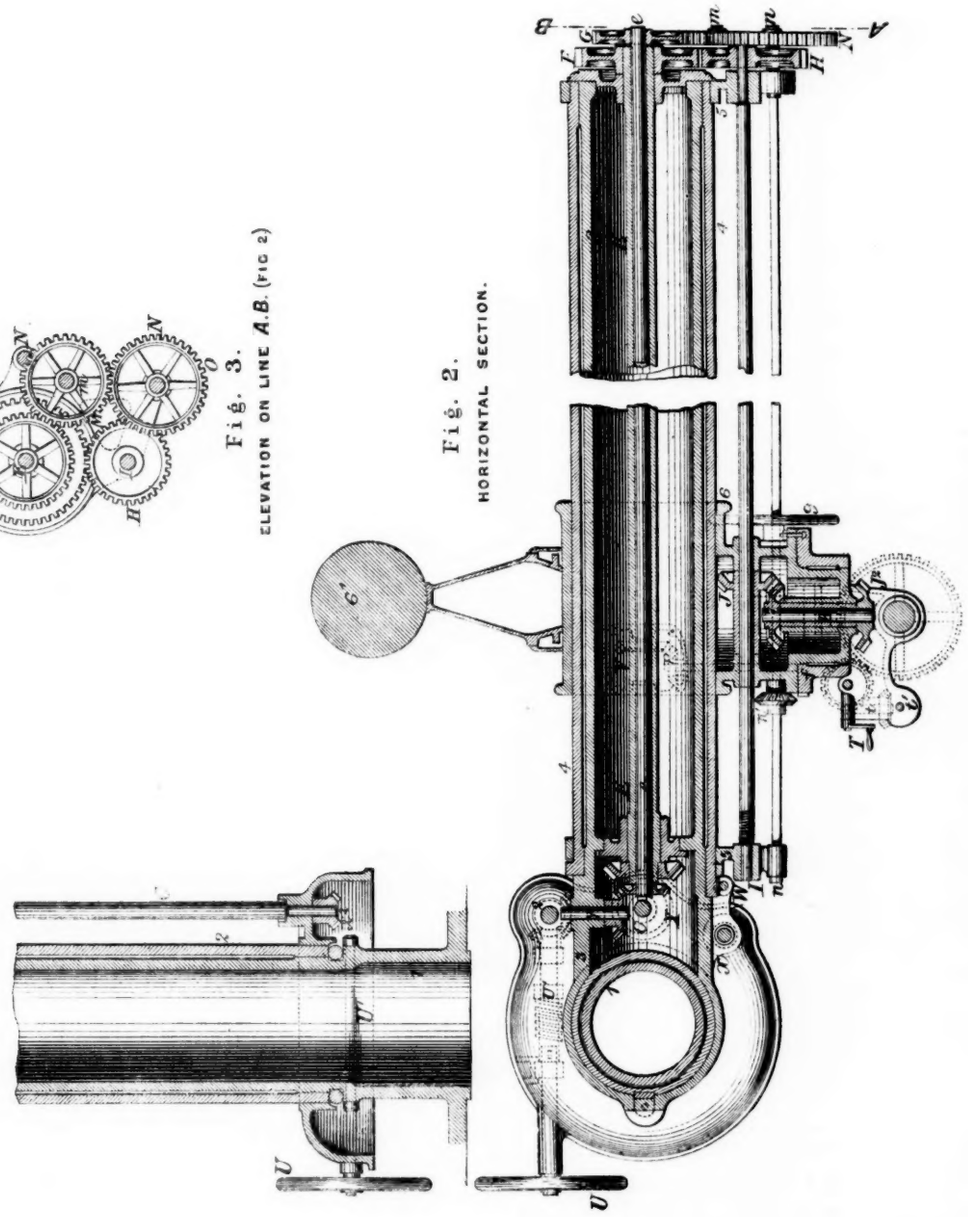


Fig. 2.
HORIZONTAL SECTION.

the wheel, 9, which, although capable of sliding along the shaft, cannot rotate independently of it. By manipulating the wheel, 9, that is by turning round the shaft, *n*, which is in communication with the tangent screw, U^1, the whole machine can be turned round on its vertical axis, 1, independently of the other movements which can be imparted to it. In a word, the effect is the same, whether it be produced by the use of the wheel, U or of 9. In the latter case the wheel is close to the point where the drill is at work, and in the former at some distance from it.

It sometimes occurs that the rotation of the shaft, *n*, should be produced by the prime mover, and not by the workman. In that case, it is necessary to render the two shafts E and *e* incapable of independent motion. For this purpose an adjusting screw is attached to one of the arms of the wheel, G, and acts upon the wheel, F. This motion is employed only when it is necessary to sweep the machine through a large arc of a circle. It is not delicate enough to adjust the machine to the exact point required. The final adjustment is invariably accomplished by hand. The rotation of the shaft, *n*, and consequently that of *e*, is not confined solely to the occasional pivoting of the machine around its vertical axis, but is also displayed in the motion of the ring or belt, 6, along the horizontal arm, 3. The vertical movement of the horizontal arm can also be performed through the agency of the prime mover. It has been explained that the arm, 3, is moved up and down the external cylinder, 2, by the screw, W, which also serves to keep it in its place. The screw, W, can be set in motion in two different ways, according to the desire of the workman. It can be manipulated by a lever and a ratchet wheel, or by means of the small shaft, X, and the two bevelled pinions, x^1 x^2, which place it in communication with the vertical shaft C. The pair of pinions, x^1, x^2, can be thrown in and out of gear, as may be required. The description of the universal drilling-machine we have just given, although somewhat lengthy, is not more so than the subject demands, bearing in mind the numerous different movements of which the machine is capable. The designer has unquestionably carried out his intention of inventing a machine capable of drilling holes in any direction whatever; and, moreover, of constructing the details of the machine in such a manner as to permit of all the movements being under the control of the workman. Without taking his attention off his work, or rather the work which the machine is performing, the workman can manipulate it as follows:—He can cause the drill to rise or fall by moving either the wheel Q, or by putting the shaft to which it is attached in gear with the motive power. He can rotate the drill round an axis perpendicular to the line of its usual action, and also move it along the horizontal arm. The horizontal arm can also be moved with equal facility around a vertical axis. These comprise the ordinary movements necessary to be given to the machine. Others are occasionally used, such as the raising or lowering of the horizontal arm, and the rotation of the drill about the arm which require the workman to give his attention more particularly to them. There is one piece of manipulation which it might appear desirable to have placed at the immediate command of the workman. It is the throwing off of the driving belt belonging to the prime mover, and so stopping the rotation of the drill. But when the drill is not working, it matters very little whether it rotates or not, and in that case the workman would have sufficient leisure, if he desired to stop it, to leave the machine for a moment and throw the band off. This universal drilling-machine we have described is not adapted for ordinary work. Its cost prohibits its application to any description of work, but that of a kind which other machines are unable to perform. But when it is applied to the work suited for it, which must otherwise be performed by hand, it effects a considerable economy both in time and money, and moreover, leaves nothing to be desired on the score of rapidity and accuracy.

THE COMMERCIAL AND MANUFACTURING INDUSTRY OF RUSSIA.

Section III.—Articles Subjected to a Chemical Process in Manufacture.

THE third section of Herr Matthäi's work is devoted to those natural productions which undergo a chemical process in course of manufacture. His work being based on observations made at the Moscow Exhibition, he dwells most fully on the commodities principally interesting in a manufacturing point of view. As our concern is rather with the statistics referring to raw material, we commence our analysis with the mineral product of most extensive use and dissemination of all those falling under the present section—common salt.

The salt produced in Russia is either rock-salt, salt prepared by evaporation from saline springs, or sea-salt. There are only four mines of rock-salt in the country; saline springs occur principally in the government of Perm; baysalt is obtained chiefly from the Caspian and the Sea of Azof. The product in 1868 was:—

Rock-salt.	Distilled Salt.	Baysalt.
Poods.	Poods.	Poods.
3,727,839	13,290,109	19,824,748

Showing a total production of about 37,000,000 poods, or nearly 600,000 tons. The return discloses a slight falling off from that of 1866, but an increase of 66 per cent. on that of 1864. The decline is wholly in the produce of the salterns or works for obtaining baysalt by evaporation from seas and lakes, which has decreased by 16 per cent. Nearly two-thirds of the annual product of rock-salt is obtained from a single mine, that at Iletskaja Saschtschita.

Price, Taxation, &c., of Salt.—As usual in countries where the public expenditure is heavy, and the imposition of direct taxes impeded by the poverty or frugality of the mass of the people, this indispensable necessary of life is marked out as the special prey of the tax-gatherer in Russia. The excise duty, unless very recently modified, is thirty kopecks (one shilling) per pood, or three guineas a ton. The import duty is 38½ kopecks per pood, except in the White Sea, where it is 22 kopecks. The average price of salt in Russia, according to Mr. Michell, is 70 kopecks per pood (6*s.* 10½*d.* per cwt.) The average price of inferior salt for curing and other trade and domestic purposes, is, according to Matthäi, 42 kopecks, or about 1*s.* 6*d.* per pood; but rock-salt for the table brings from 7*s.* 6*d.* to 11*s.* The disadvantage of these high rates to the health and comfort of the people, and to various branches of industry, is too obvious to require pointing out; but the tax is one of those which, from their lucrative character and ease of collection, financiers are most reluctant to abandon. According to Matthäi, it is one great cause of the inferiority of Russian cattle, and the scarcity of salt which it occasions is the principal reason of the extremely devastating character of epidemics among live-stock in the country. Mr. Michell recommends that a drawback of duty should be allowed upon salt imported for agricultural purposes, or the curing of fish, a principle already admitted in some degree by the exemption of salt imported for the manufacture of soda. Were this permitted the importation of salt would no doubt be very large. It is probably considerable even now. It will be remembered that the first (and almost the only) Russian prizes taken at sea during the Crimean war, were vessels returning with cargoes of baysalt from Setubal. We have no statistics of the total importation before us: that from England in 1872 (most probably entirely of rock-salt) was 65,947 tons, of the value of £42,949, showing an increase of 20 per cent. upon the amount of the preceding year.

The manufacture of salt appears to be still, to some extent, a government monopoly in Russia. We are not informed of the details of the system.

Various Chemical Products.

(*a.*) *Chemical Dyes.*—Twenty chemical works were represented at the Moscow Exhibition, six of which were exclusively devoted to the manufacture of dyes. The most important of these factories, concerned with the general manufacture of chemicals, is the firm of Maljutin and Sons, of Dochterow, in the government of Moscow, which annually manufactures 4,000 tons of chemical wares of the value of nearly £400,000 sterling. The most remarkable of their manufactures is madder, obtained from one of the finest varieties of the plant, called *Marena*, which is grown in the neighbourhood of Derbent, in Daghestan. This forms the base of one of the best varieties of the brilliant dye *garancine* (extract of madder). The Derbent madder is sold at 15 roubles per pood, the garancine prepared from it at 29. Derbent madder is also the base of the much-esteemed Russian-Turkey red dye.

(*b.*) *Albumen.*—This important artificial product is manufactured in two ways—from blood and from white of egg. The former is recommended for encouragement on the obvious ground that the refuse of the slaughter-houses cannot be turned to any equally useful account, while the consumption of eggs for manufacturing purposes tends to limit the supply of an article of food. Russia's produce of eggs is, indeed, vastly in excess of her requirements, and might be indefinitely extended. We are all aware of the great rise in the price of this commodity in England of late years, and we now learn from Herr Matthäi

that the London market is partly supplied by Hungarian eggs sent by railway. Why, he asks, should not Russia export eggs also? a suggestion which we commend to the attention of the purveyors of our markets. The produce of eggs is said to be especially large, and the price fabulously moderate, in the districts near the mouths of the Volga, inhabited by the Tscheremissians, Tschuwassians, and Mordwinians. So soon, however, as the Mordwinians, Tschuwassians, and Tscheremissians discover that the commodity is in demand, they will be quite sophisticated enough to raise their prices, to meet which Matthäi recommends that contracts for delivery, guaranteed by an advance of part of the price, should be concluded at the dead season of the year. Only four firms appear to have contributed manufactured albumen to the exhibition. In two cases the preparation was from eggs, in the other two from blood. The preparation of the latter is spoken of as unsatisfactory. The price of the blood-albumen ranges from 20 kopecks to 1 rouble per Russian pound ($1\frac{1}{9}$ of an English pound). The crystallized egg-albumen, principally used in the manufacture of soap, costs $1\frac{1}{4}$ roubles per Russian pound.

(*c.*) *Soda.*—Only two factories of soda were represented in the Exhibition. The price of the commodity is 2 roubles 35 kopecks a pood. The restrictions on the importation and manufacture of salt are described as very prejudicial to this manufacture, notwithstanding the drawback allowed by government.

The exportation of all descriptions of alkali from the United Kingdom to Russia, was, in 1872, 261,253 cwts., of the value of £174,566, showing an increase of about eight per cent. amount, and about 30 per cent. value on the preceding year.

(*d.*) *Potash.*—According to the returns of the Ministry of Finance, Russia possessed, in 1868, 206 potash distilleries, employing 1,198 workmen, with an annual product of 455,982 roubles. The exportation, however, for the same year, was 527,359 poods of the value of 1,212,927 roubles, and as at least an equal quantity must have been consumed at home, especially for the soap manufacture, the official returns are evidently enormously under the mark. The value of export, in 1870, was 1,493,425 roubles, so that the entire worth of production may be estimated at three million roubles (about £470,000). According to Matthäi, this production is susceptible of great increase without laying the forests under excessive contribution. The indifferent management of these forests fills them with fallen wood, underwood, dead timber of all kinds, which is allowed to decay where it lies. Although the amount of potash obtainable from the distillation of dead wood is somewhat less than that from freshly hewn timber, it still amply repays the expense of manufacture; while the facility of transport, as compared with that of timber, would make the manufacture remunerative in those forests whose produce has hitherto been excluded from the market, by the cost of conveyance. The ashes of the wood used for fuel in Russia (principally birch) are exceedingly rich in potash, the extraction of which might be a source of great profit. The best Russian potash is made in the government of Kasan.

(*e.*) *Pitch, Tar, Turpentine.*—The returns of the Ministry of Finance for 1868, show 440 tar distilleries, with 690 workmen, and 112,550 roubles annual product, and 229 distilleries of pitch and turpentine, with 693 workmen, and 315,558 roubles annual value. The entire inadequacy of this estimate is patent from the fact that the exportation of pitch for the same year amounted to 137,941 barrels, of the value of 703,528 roubles. The export of tar, curiously enough, was only 320 barrels, worth 960 roubles. The abundance of coal-tar in other countries may limit the trade, as well as the recent introduction of petroleum and other mineral oils. Matthäi, however, entertains no doubt that the production of tar, pitch, and turpentine might be very greatly increased by a more judicious administration of the forests. It must be recollected that the manufacture of these commodities, and also that of potash, is to a large extent in the hands of workmen acting in co-operation, or of individuals prosecuting it on a very small scale, which serves to explain the incompleteness of the official returns.

(*f.*) *Lucifer Matches.*—The official returns give eighty-five factories, with 2,214 workmen, and an annual product of 488,421 roubles. The production would appear to have increased subsequently, the seven firms represented at the Moscow Exhibition returning 174,408 roubles annual produce, notwithstanding a considerable decline in prices. The quality of Russian lucifers is so good that they are beginning to constitute an article of exportation. *Sulphur* is found in the Ural mountains and the Caucasus.

General Condition of the Manufacture of Chemicals in Russia.—On this head we cannot do better than abridge the observations of M. Kolesoff in his report on the Russian tariff, translated in the report by Mr. Michell, to which reference has so often been made. Under the protection of high duties, says M. Kolesoff, a number of small chemical works were established between the years 1821-51, the owners of which possessed no chemical knowledge, and sold goods damaged by injurious compounds, or carelessly prepared. The extreme dearness, besides, of our chemical products and colours sensibly affected the price of our tissues. The reduction of the duties on those articles by the tariffs of 1850 and 1857, put an end almost entirely to the production of chemicals, which cannot be made cheaply in Russia. In 1863, ninety-eight chemical works, employing 2,600 men, produced, in round numbers, 12,300 tons of chemicals, more than 40 per cent. of this quantity being sulphuric acid. In 1865, the importation of chemicals from abroad was 2,150,000 roubles declared value, 850,000 roubles being for soda alone. The value of the manufacture in the country itself was estimated at 3,000,000 roubles (£450,000) a decline of 33 per cent. from that of five years previous. The quality of the manufacture was pronounced excellent by the jurors of the Exhibition of 1865. "It was, however, acknowledged that this excellence is gained at a great cost to the producer, as, under present circumstances, the preparation of salts, acids, and even of many colours, belongs to the least profitable branches of industry in Russia. In Western Europe common salt employed for chemical purposes is exempt from duty; while the materials for muriatic acid and citric acid are obtained almost for nothing by the foreign manufacturer. These circumstances place our chemical manufacturers at a great disadvantage. The jurors arrived at the conclusion that the products could only be worked under very careful management, and with but small profits."

Wax, Tallow, Oil, &c.

Wax.—The production of honey and wax in Russia is considerable, and might be enormous. Its capacity for development is shown by its not amounting to half of that of the Austrian Empire, being returned at 3,000,000 roubles (£450,000), rather more than 50 per cent. of this being for wax. The production of honey, by weight, is estimated at 460,000 poods (7,500 tons), that of wax at 100,000. No culture could be more profitable for the peasantry. An outlay of six to eight roubles would, in three years, produce 50 hives, with an annual product of 150 roubles value. A more scientific management is indeed indispensable, and especially the discontinuance of the practice of destroying the bees in taking the honey. The principal areas of production are at present the governments of Pultawa, Koursk, and Orenburg, in which latter it is carried on by the semi-civilized Bashkirs, some of whom keep 1,000 hives apiece.

Statistics of the Wax Manufacture.—These are very diversely returned by Timirjasew and the Department of Finance. According to the former authority, Russia, exclusive of Poland and Finland, has 132 wax-light manufactories, with 668 workmen, and 2,110,000 roubles (say £300,000) annual product. The official returns give 110 such factories, with 563 workmen, and 1,623,785 roubles product, which estimate Matthäi shows to be below the truth. The same returns add for other branches of the trade:—

Wax-boiling Establishments.

Works.	Workmen.	Value. *Roubles.*
83	283	301,933

Wax-bleaching Establishments.

Works.	Workmen.	Value. *Roubles.*
17	174	816,780

The manufacture is to a great extent dependent upon the employment of wax-candles and tapers in religious services, the annual value of these being estimated at 800,000 roubles, or 28 per cent. of the whole manufacture. Many of these candles are extremely beautiful. In general, however, the quality has deteriorated from the wax being largely mixed with paraffine.

The exportation of honey and wax from Russia, formerly considerable, is now exceedingly small.

Tallow.—This, as universally known, is one of the most important of Russian products, but the facts connected with it admit of being presented in a narrow compass. The principal production, of course, is on the wide steppes of Siberia and Southern Russia, where cattle are bred out of all proportion to the demand for meat. The total amount made is estimated at from ten to twelve million poods, by much the greater part of which is retained for consumption in the country. To the abundance of tallow Russia is indebted for her soap and stearine manufactures, of which we shall treat presently. The exportation has greatly diminished of late years. Before 1868 it was estimated at 3,000,000 poods per annum. In that year it declined to 2,439,000, and by 1870 had sunk to 1,329,000 poods, or about 21,000 tons. The import of Russian tallow into the United Kingdom for 1872 is not shown by the returns. That of tallow

and stearine of all descriptions was 2,781,671 cwts., of the value of £2,671,527.

According to the returns of the Ministry of Finance, Russia has 670 manufactories of tallow candles, with 2,105 workmen, and an annual production of 4,892,107 roubles. The same authority enumerates 16 manufactories of stearine candles, with 2,137 workmen, and 7,337,642 roubles production.

The manufacture would appear, from M. Kolesoff's statements, to present considerable room for improvement. "Some," he says, "of the works established on a larger scale melt the tallow according to improved methods, but the greater part, especially the smaller establishments, melt it in boilers placed on an open fire. The bones, heads, and other parts of the animals are thrown together into these boilers, and no care is taken to separate the tallow from the flesh. The tallow obtained in this way cannot, of course, be good; it is very soft, contains various fatty substances, glue, and other matter, and consequently soon decomposes. This tallow cannot be used for the manufacture of good candles or soap."

Soap.—The returns of this important industry are difficult to obtain with precision, on account of the general combination of the manufacture with that of tallow and stearine. The returns of the Finance Ministry give for the empire, excluding Finland, 353 soap manufactories, with 1,256 workmen, and a production of 3,155,352 roubles. Timirjasew, who classes the soap-boiling establishments along with the tallow-chandleries, returns for both 874 factories, with 2,734 workmen, and an annual production of 6,606,325 roubles. Many of these establishments are, no doubt, on so small a scale as to escape enumeration, and the produce of some of the larger appears to be on the increase. The discrepancies in the productive power of the individual workman are very remarkable, ranging from only 975 roubles to 14,000 per head annually. The latter high figure is attained in the soap manufactory of F. A. Kyber, at Moscow, where steam-power is employed, and the excellent organization of which is cited as an example of what a more judicious economy of labour might effect for Russian manufactures.

With reference to the general condition of the Russian tallow-trade, Herr Matthäi remarks that it is an instance of what he has so frequently insisted upon, the advantage of the exportation of produce in a manufactured instead of a raw state. With her great production of tallow Russia should be able to supply foreign countries largely with candles, but even the stearine and oleine obtained in the soap manufacture leave the country in the form of cakes, and the exportation of the former is greatly declining, although that of the latter increases. The prosperity of the candle-trade, so far as internal consumption is concerned, is insured by the length of the winter nights and the impossibility of any general consumption of gas, or even of paraffine, so long at least as the import duty of one rouble per pood is maintained, or the article is not produced in Russia itself. Paraffine and kerosene, however, have greatly interfered with the demand for stearine-candles abroad, especially in Germany, and the export trade is not likely to recover itself until the Russian manufacturer becomes more enterprising, and resolves to work at cheaper rates in the prospect of a larger demand. A reduction of price would also be advisable in prospect of the possible competition of a domestic paraffine manufacture. With the exception of the naphtha of the Caucasus, of which we shall speak presently, no mineral substance capable of yielding paraffine has yet been discovered in Russia, but there is reason to expect that peat, or some of the varieties of lignite with which the country abounds, will prove available for this purpose. In the last place the export of soap, although still small, displays a very considerable augmentation.

Cosmetics, perfumery, &c., are largely manufactured, to the annual value, in Matthäi's opinion, of about 3,000,000 roubles, though the official returns put it at less than the half. According to the latter authority the number of manufactories in 1868 was 28, with 635 workmen. Russia possesses a speciality in this department in her egg-soap, no other European country having eggs to spare for manufacturing purposes. The manufacture is principally carried on at Moscow and Kasan. The Imperial Soap Company, whose head-quarters are at the latter place, annually uses 8,000,000 eggs, principally procured from the governments of Kasan, Viatka, and Simbirsk. This soap is apparently in chief request for application to the hair, and the consumption is said to be at present somewhat on the decline owing to the competition of glycerine.

Glue.—The number of glue-works in Russia is returned at 102, with 552 workmen, and 152,745 roubles annual produce. The exportation in 1868 was 4,759 poods, worth 136,169 roubles. The amount produced might be increased thirty-fold if more care were taken to collect and preserve animal refuse for manufacturing purposes. The price is in general from 7 to 10 roubles per pood.

Isinglass and other fish-glue was exported in 1868 to the amount of 3,492 poods, of 349,200 roubles value. The isinglass exhibited at Moscow was priced at from 75 to 110 roubles per pood. It is chiefly made at Astrachan.

Bones.—Our author is exceedingly emphatic on this subject, which he regards as a crucial instance of the soundness of his remarks on the defects of the Russian industrial and commercial system. Over a large part of Russia, he says, bones are entirely wasted; and where this is not the case they are collected for exportation, nobody reflecting that their fertilizing properties have been derived from the soil, and that the prospects of future harvests are being sold along with them. In 1870, 976,000 poods (15,000 tons) were exported to England and Germany, which amount, had it been kept at home and employed in agriculture, might have been exported in the more lucrative and acceptable shape of 6,000,000 poods of wheat—an illustration of the advantage of the export of manufactures over that of raw material. (The import into the United Kingdom of bone-dust, including animal charcoal, for the first eleven months of 1872, was 88,000 tons, of the value of £579,610.) Of late years more attention has been paid to the collection of bones on account of the demand for animal charcoal in the manufacture of beetroot-sugar. The official returns for 1868 give 22 establishments engaged in the manufacture either of animal charcoal or of bone-dust, with 195 workmen, and an annual production of 292,774 roubles. This estimate, however, is much too small, the five firms represented at the Moscow Exhibition alone producing 340,000 roubles. The quality of the manufacture is good, but the price is too high to meet the views of Russian agriculturists. Bones are sold by the collectors at from 15 to 20 kopecks the pood; in the districts where their use as manure is as yet unknown they may be had for 10 kopecks.

Oil.—The oil manufacture of Russia belongs to the category of those which are largely carried on as an appendage to agriculture, and accordingly do not figure to their full extent in the official returns. These latter give 1,903 oil-mills, with 6,454 workmen, and 2,408,247 roubles annual value; but according to Von Buschen, the actual production is 11,250,000 roubles, and Matthäi considers even this estimate too low. The production is chiefly linseed and hempseed oil; besides which, oil is largely extracted from the seeds of the sunflower and the poppy, and from mustard-seed. The latter is used as an article of diet during seasons of fasting, on account of its nutritious properties. The average price of linseed-oil is 4 roubles 80 kopecks the pood, and of sunflower-oil 4 roubles 30 kopecks. In 1868 the amount of each exported was—

Linseed.	Sunflower.
143,622 poods.	21,974 poods.

Both showing an enormous increase on the exportation of 1861. In 1869, however, the export of linseed-oil fell to 65,910 poods, and in 1870 to 2,081, a return so incredible, notwithstanding the paralyzing influence of the war, that one is inclined to suspect some misprint. We do not find the expressed oil discriminated from oil-cake, which is no doubt the form in which most of it reaches this country. In the first eleven months of 1872 the importation of seed-oil of all descriptions and from all parts of the world into the United Kingdom was 16,926 tons, of £668,023 value, an increase of 100 per cent. on the preceding year. The importation of oil-cake for the same period was 125,494 tons, of £1,171,790 value, showing a slight falling off.

The present is a convenient opportunity for introducing a remark which should have been made in the section on flax. It is that "in order to obtain from the flax-plant not only the fibre but also the seed, Russian cultivators allow it to ripen, which makes the fibre coarse, while in other countries the flax is cut when only half ripe, in order to obtain a soft fibre, even at the sacrifice of the seed. This is why Russian flax is not at all used abroad in the manufacture of fine linen."

Rock-oil, Naphtha.—According to Skalkovsky's tables of Russian mineral industry, the produce of mineral oil in Russia for the year 1868 was 1,753,984 poods, of the approximate value of 7,000,000 roubles. This estimate shows a considerable increase on former years, ascribed partly to more favourable arrangements with the Government, and partly to improved methods of working. The pits are almost entirely situated in the Caucasian provinces; a few have been recently opened in other parts of Russia, and hopes are entertained of rendering peat available for the extraction of mineral oil by Barth's process. Russia ought to be a large exporter of this commodity, instead of being, as was the case in 1870, a customer of foreign nations for petroleum and kerosene to the extent of 5,764,000 roubles.

Varnish and Sealing-wax.—The official returns give 29 manufactories of varnish, with 465,480 roubles product, and 13 of sealing-wax, with 195,796 roubles. Judging from the returns of individual firms represented at the Moscow Exhibition, these

statistics are much below the truth. The quality of both manufactures is very good, most of the sealing-wax sold in Russia as French or English being in fact made in the country.

Leather and Hides.

Russia, says Herr Matthäi, should be able to supply the whole of Europe with tanned hides. Notwithstanding this, her exportation consists principally of undressed leather, and as the export of leather is considerably greater than the import, it may be said that a considerable portion of her exportation comes back to her in a more finished form, for which she gives a higher price than she received. There is really no reason why all Russian hides should not undergo the manufacturing process in the country, the indifferent organization of labour excepted, of which we shall speak presently. The export, however, both of dressed and undressed leather is on the increase, or at least was so until 1870, when the obstruction of the Baltic carrying trade deranged all commercial operations. In 1868 the exports were as follows :—

Description.	Amount. *Poods.*	Value. *Roubles.*
Russia (*yuft*) leather . . .	21,059	231,649
Other prepared leather . .	19,180	383,600
Raw hides	343,143	2,386,355

The export of raw hides being thus nine-tenths of the whole. These figures, however, show an increase, for leather, of 30 per cent. for hides ; of 130 above those of 1861 ; and it must be assumed that the subsequent decline is exceptional and temporary. On the other hand the importation of leather has increased in an even greater ratio, that for 1868 showing an advance of 169 per cent. in quantity, and 190 per cent. in value. The amount in the former year was 27,649 poods, the value 860,796 roubles. The balance against Russia being consequently 245,547 roubles.

The number of tanneries in Russia was returned in 1868 as—

Tanneries.	Workmen.	Annual product. *Roubles.*
2,845	15,768	20,595,729

According to the estimate of M. Kolesoff (*apud* Michell, p. 295) the number of raw hides obtained annually is 20,500,000, of which 19,000,000 are dressed. Deducting sheep-skins, or more than 50 per cent. of the whole, the numbers and weight may be taken as—

Description.	Number.	Avg. weight singly in lbs.	Collective weight in pds.
Horse-hides .	1,000,000	12	300,000
Ox-hides . .	2,200,000	40	2,200,000
Cow-hides . .	1,300,000	20	650,000
Calf-skins . .	4,000,000	3	300,000

Estimating the average value of the hides at 11 roubles per pood, the value of the hides dressed will amount to 34,650,000 roubles. Including uncut sheep-skins used for clothing and morocco leather, the total annual product is estimated by Von Buschen at 56,000,000 roubles. The ordinary price is 9 to 10 roubles per pood, but Russia leather or *yuft*, and calf-skin are sold at from 12 to 13 roubles. In 1867 about 250,000 poods of *yuft* were supposed to be prepared annually, of which, as we have seen, not more than 21,000 were exported, at least, to Europe. In last century the export reached 140,000 poods annually. The falling off is principally owing to the improvements effected in the leather manufacture abroad.

Condition of the Manufacture.—"The manufacture of leather," says M. Kolesoff, "may be said to be generally in a declining condition, and requires the adoption of those improved methods which brought this industry to a high state of perfection in Europe. It is pursued mostly in a rough, practical way, and not based on any scientific method. It is in the hands of men who possess but little capital, whereas considerable amounts must be sunk before satisfactory results can be obtained. If we consider that, unless machinery is employed, more than a year is necessary for curing a hide of middling thickness, it is evident that only a rich manufacturer can afford to employ his money in the process. Improvements are as yet far from being generally adopted ; and all amelioration encounters considerable obstacles on the part of the small leather dressers in the villages, whose skins though bad are cheap, and thus find a ready sale."

Matthäi directs attention to the great disproportion in the individual value of labour which obtains in this as in other leading Russian industries. It varies from 2,917 roubles annual production per head in the government of Tula to as little as 209 in Podolia. The discrepancy, however, is said to be less than formerly.

Special Descriptions and Applications of Leather. (*a.*) *Russia Leather.*—The *yuft*, to which reference has been made, is of two descriptions, the black and the red. The best description of the former is made in the government of Kostroma, the latter in Kasan and St. Petersburg. The water of the Neva is peculiarly suitable for this description of tanning. An indispensable requisite for the manufacture is willow-bark, which abounds all over Russia.

(*b.*) *Morocco Leather.*—This is also a speciality of Russia, but was indifferently represented at the Exhibition.

(*c.*) *Boots and Shoes.*—The manufacture of boots and shoes in Russia is to a large extent carried on by the associated labour of communities of workmen labouring on their own account. Great quantities of shoes are made in this manner at Kyrma in particular. Much work is also given out by the large dealers, and it is only of late that boot and shoe factories on a large scale have been established, which promise to be successful. The most important is that of Jegorow at Moscow, which executes work to the annual value of 250,000 roubles, principally by machinery. One interesting feature of the trade is the "Artell" or co-operative association of the St. Petersburg masters and journeymen, with seventy members and a manufacture of 40,000 roubles annual value. The quality of Russian boots and shoes is unfortunately very inferior, unless when they are very dear. A good pair of boots at St. Petersburg costs nearly three times as much as at Vienna. There is, consequently, notwithstanding the high rate of duty, a considerable importation of foreign boots, or rather of upper leathers, the soles being made and added on in Russia.

(*d.*) *Saddlery, Portmanteaus, &c.*—Russian work of this description is frequently by no means bad, but when this is the case it is dear. There was consequently in 1868 an importation of 4,584 poods of foreign work, to the declared value of 270,441 roubles. This, however, is far from corresponding to the real amount of importation, as almost all Russians who travel buy more or less of saddlery or other work in leather abroad, which is subsequently introduced into Russia without paying duty.

(*e.*) *Gloves.*—The same remark applies to gloves, the best kid produced in Russia being sold at extravagant prices. The inferior descriptions are more reasonable in proportion.

Furs and Peltries.

The gross production of fur in the Russian empire is, of course, considerably diminished by the cession of the Russian territory in North Western America to the United States. The decline in the produce of furs from this quarter had, however, been most serious, having fallen between 1838 and 1847 from an annual average of 427,000 roubles to one of 194,000. There are, unfortunately, no recent statistics respecting the produce of the European and Siberian trade. The number of skins annually obtained in Siberia was estimated in 1825 at 546,350 ; in 1830 at 381,485. About eight per cent. of the latter estimate belonged to the finer varieties, such as sable, ermine, arctic fox, &c. The total export of undressed skins was estimated in 1857 at 2,735,090 roubles' value, in 1867 at 1,196,600—a decline of about 20 per cent. The importation, on the other hand, had risen from 2,138,000 roubles to 3,196,000—an increase of 50 per cent. This is a proof both of the enhanced demand for furs in Russia and of the diminished supply of the finer varieties which she produces. The latter appears still more clearly upon a comparison of her exports for various years as estimated by weight. It appears that while the export of various specified descriptions, including seal-skins, was, for 1861, 2,321 poods, of the value of 882,830 roubles ; the weight was 7,639 poods, while the value had fallen to 252,087 roubles. It thus appears that the great increase in quantity must have been due to the demand for the comparatively cheap article of seal-skin, which is known to have sprung up in Western Europe during the period. The export of manufactured furs had risen from 20,000 roubles' value in 1861 to 74,000 in 1868—a considerable increase, though the amount is still relatively very small.

India-rubber and Gutta-percha.

It will probably be thought surprising that Russia should contain one of the most important india-rubber and gutta-percha manufactories in the world. This is that of the Russo-American Company, the annual production of which, with that of two minor establishments, is estimated at nearly 2,000,000 roubles. Waterproof cloth of various descriptions is also manufactured to the annual amount of nearly 300,000 roubles.

Paper.

Russia should be in an especial manner the land of the paper manufacture, for few other countries can show an equal production of rags. The proportion, however, between the raw and manufactured material is by no means satisfactory. The pro-

duction of paper is, indeed, on the increase, and the enhanced demand for printing-paper in particular is a gratifying proof of the progress of education in the country. But the demand is permitted to outrun the supply, and the trade is frequently subjected to sudden rises of price from the inadequacy of production to keep pace with consumption. While these rises are occurring Russia is steadily exporting the raw material which would enable her to meet them to the extent of 403,000 poods annually, of the collective value of 302,000 roubles, notwithstanding an export duty of 30 to 45 kopecks per pood. The price per pood may, therefore, be averaged at 73 kopecks, or something less than half of the average value of rags in foreign countries. The vast advantage of the Russian manufacturer is apparent at a glance. In addition he has the benefit of a protective import duty of three roubles per pood on glazed and two on unglazed paper. Notwithstanding these advantages 22,217 poods of various descriptions of paper, of 517,945 roubles' value, were imported in 1868. This amounts to about one-eleventh of the indigenous production, which, according to the official returns for 1868, then stood as follows:—

Factories.	Workmen.	Annual Production in *roubles.*
158	9,527	5,747,681

According to Timirjasew (not comprising Poland and Finland):—

Factories.	Workmen.	Production.
134	8,054	5,522,181

According to the more detailed returns of 1862, as given in M. Kolesoff's report, the aggregate yearly production of 165 mills and 12,000 workmen amounted to 5,680,000 roubles. These mills manufactured in all 2,102,000 reams of writing, printing, drawing, and other paper; 572 [000?] reams of wrapping and sugar-loaf paper; 49,370 poods of glazed cardboard, and 79,515 sheets of ordinary pasteboard. The greatest quantity manufactured was in the provinces of St. Petersburg, Livonia, Kaluga, Yaroslav and Novgorod; 37 of the 54 mills which made paper by machinery belonged to these provinces. Ten of these were regarded as first-class. The average annual ratio of production to each workman is reckoned by Timirjasew at 685 roubles, varying from 1,217 roubles in Novgorod to only 121 in the government of Orel.

Rise in the price of Rags, substitutes proposed.—Since 1868, the year of the last official returns, the price of rags has risen very rapidly, the augmentation being at least 100 per cent. Many substitutes have been proposed, more especially wood, which is recommended by its abundance, and actually employed more or less in most manufacturing establishments. The Finnish manufactories prepare wood-paper of three descriptions, from 1 rouble 50 kopecks to 2 roubles 25 kopecks per pood. Another resource has been found in the admixture of fine white clay (kaolin), with the material of the manufacture, much as sizing is employed in the preparation of cotton goods, and, as in the latter case, occasionally carried to the point of adulteration. A more organized system of collecting rags would, in Matthäi's opinion, be a better remedy than this mineral succedaneum.

Paper Manufactories of especial interest.—Two may be considered as really remarkable. One of these is the Imperial establishment for the manufacture of paper for bank-notes, bonds, and other national obligations, which is considered one of the best in Europe. It is especially distinguished for its prompt adoption of the most recent improvements in machinery, and at present employs seventeen steam-engines of 470 horse-power, with 382 other machines of various descriptions. The value of the plant is estimated at 4,000,000 roubles, and the number of workmen is no less than 1,912. The exchequer bills, &c., of the Government are manufactured from hemp unmixed with any other material. The establishment also produces paper for private customers, but only such as is stamped or engraved; a printing and lithographic establishment accordingly forms part of it. The preparation of bank-notes and other public securities, consumes about 100,000 sheets of paper annually. Some of these, according to the description of the document, are made by hand, others by machinery imported from Rochdale. An artesian well has been sunk to the depth of 600 feet to obtain a supply of water, which unfortunately is not of suitable quality. Another remarkable establishment is that of A. Galnbeck in Moscow, which employs nearly 1,600 children in the manufacture of paper rolls for cigarettes, to the annual number of 275,000,000, and the value of 90,000 roubles.

Paper-hangings.—The manufacture of paper-hangings, according to the official return, employs twenty-six factories with 926 workmen, and an annual production of 612,610 roubles. The quality is in general exceedingly good, but the price is too high. The importation of foreign paper-hangings is accordingly not inconsiderable, the demand being great in Russia, where, as in England, even the smallest rooms are papered. *Asphalte paper* for roofing is also coming much into use, an article apparently replacing the tarred felt sometimes employed in England. It is recommended for workshops where sulphur is employed, sulphuric fumes being destructive to iron roofing, and is also advantageous in Russia, where slates are scarce, as an incombustible material. In the last place, there are two or three respectable factories of papier maché.

NOTES FROM THE NORTH OF EUROPE.

Coal in Skane.

THE steam-boring machine of Mr. Stegeman and the parties interested with him, has again struck coal at Wiken, at a depth of about 750 feet. The seam of coal penetrated is practically workable, say over six feet, of which four feet are coal, which can thus be worked by galleries about six feet high; and it is further shown by this boring that we have hitherto only been acquainted with upper seams which, although available, are of a looser character, while the best and thickest can only be expected lower down.

And as seams of coal in many places abroad must be sought for and worked at a depth of several thousand feet, it is somewhat encouraging, considering the result of former trials, to see that seams of coal in Skane have been already got to at a depth of something over 700 feet.

New Steam-Boat Communication.

From "Morgenbladet."

From the commencement of the present season's navigation, the new steamer of the "South-east of Sweden Shipowning Company," which will be ready next April, will make regular passages between England, Antwerp, Copenhagen, the south of Sweden and Norrköping.

The Norwegian Ice Trade.

From "Morgenbladet."

A meeting has been held at the Christiana Exchange respecting the export of ice. It was agreed that something ought to be done for the better organization of the trade; that, at least once a year, a meeting of the dealers in ice should be held in Christiana, and that a committee should be appointed to take the subject further in hand.

Malmö.

From "Handels & Industri Tidning."

The Steamship Company Aegir's second steamer was launched on the 31st December from the shipyard of Messrs. Bertram, Haswell and Co., Sunderland. It was christened the "Kolga." This vessel, which will carry 750 tons dead weight, was fitted at Newcastle with engines of eighty horse-power. The "Kolga" is intended to sail regularly between Malmö and England, probably Newcastle, and will be suitably fitted up for the conveyance of cattle. This trade can probably be commenced in the early part of this year.

From "Handels & Industri Tidning."

A shipowning company of very considerable importance, and the first of its kind in Sweden, has lately been founded by some prominent firms in the capital, who intend to open regular communication between Stockholm and New York, touching at Southampton, and when required, at Gothenburg. They propose building two iron steamers, each of about 2,000 tons burthen, adapted for the conveyance of passengers as well as goods. The capital required, one and a half millions of "Riksdalers" (equal to £85,000), is already fully subscribed.

The Norwegian Arctic Expedition.

From "Aftonbladet."

The following report has been received of the attempt to reach Spitsbergen by the Isfjorden, and to land there. The "Isbjörnen" put to sea the 2nd January; during her voyage up the weather was mild, and the wind at first S.W., but afterwards changed to N.E., with increased cold. On the 7th January the temperature was ten degrees (centigrade) under freezing point. In the night, between the 7th and 8th January, they sighted Bear Island, about three miles distant. The 8th January, wind S.S.E., with snow. They had now got into loose ice,

and shore ice was perceived to the N. and E. The route northwards being thus closed, they determined to skirt the shore ice in a westerly direction. The idea of reaching Bear Island, to deposit stores there in case they should be compelled to leave the ship in the ice, and find their way back to the Island, had to be abandoned. They now steered westward, but the difficulties continually increased. In consequence of the ship and sails becoming frozen over, at last it was next to impossible to handle the frozen sails, and it was necessary to abandon the attempt; and in the afternoon of the 8th January they determined to make for the south. On Thursday, the 9th, a violent gale blew from the south. On the 11th they reached Sorven. The darkness was no great hindrance to the navigation, although the daylight was very dim, and at noon they could hardly see to read on deck. Although during the voyage up it was not moonlight, and at the same time thick with rain, it was still moderately light. The aurora borealis shone brightly under the edge of the clouds; thus, on the night between the 7th and 8th January, they were able to see Bear Island, three miles off. The present hindrances to the navigation arise from the sails becoming frozen, and it is probable that no sailing vessel can reach Spitsbergen at this time of the year. It would probably be attended with great risk even for a steamer to force its way higher up. Rosenthal's plan of sending a steamer to Spitsbergen will no doubt contribute interesting information about the state of things, but the probability of reaching Isfjorden in January or February is certainly little or nothing. It may be otherwise in November, and perhaps in December also. This attempt has thus failed, but most assuredly everything has been done which was within the power of man.

THE TRADE OF RUSSIA.

From a Correspondent of the "Stockholm Dagblad."

The Customs Department has lately published a complete statement of the trade of Russia for the last ten years. The total value of the imports and exports for 1871 appears in the following table, which comprises the whole trade of Russia in Europe and America, and shows how the transactions are apportioned to each country. The values are given in silver roubles.

The Exports of Russia for 1871.

	Roubles.
England	171,777,620
Prussia	61,828,563
France	33,978,079
Austria	13,859,847
Hanseatic Towns	3,163,577
Turkey	10,190,206
Holland	14,824,486
Italy	8,428,788
United States	864,830
Belgium	9,541,972
Germany	9,917,767
Sweden and Norway	4,963,329
Roumania	2,428,098
Greece	1,856,705
Denmark	2,607,135
Spain	378,150
Portugal	657,657

The Imports of Russia for 1871.

England	97,284,044
Prussia	141,439,932
France	12,404,712
Austria	16,747,992
Hanseatic Towns	19,452,823
Turkey	11,577,531
Holland	6,173,039
Italy	10,456,372
United States	16,969,624
Belgium	4,916,090
Germany	1,824,269
Sweden and Norway	4,167,205
Roumania	3,343,824
Greece	3,767,353
Denmark	362,719
Spain	1,484,440
Portugal	611,690
South America	1,309,458

In comparing these figures with those of the year 1862 it appears that the trade of Russia with Greece has increased tenfold in the ten years, that the trade with the United States has increased eightfold, with Sweden and Norway sixfold, with Germany fivefold, with France, Italy, Austria, and Turkey, fourfold; with the Hanseatic cities, Holland, Portugal, and Roumania it has doubled, and with Denmark remained without alteration. On the other hand, the trade with Spain and the West Indies has diminished during the above period. On looking into the enormous extent of the traffic between Russia and other countries, we find that England and Prussia occupy the foremost place. Ten years ago, when the trade of Russia was not more than 300,000,000 of roubles, the proportion of England (including both imports and exports) was 119,000,000 of roubles, and that of Prussia, 56,000,000; and now that the whole trade of Russia for 1872 has increased in round numbers to 700,000,000 of silver roubles, the proportion of England in this trade is 268,000,000, and that of Prussia, 202,000,000 in round numbers. England's share of the trade with Russia has thus certainly in the last ten years followed the progressive movement, but her proportion has only altered from 39⅔ per cent. to 38⅔ per cent., whereas the trade with Prussia in the same space of time has been considerably increased, say from 18⅓ per cent. to 28⅚ per cent. of the whole. When we now consider the various ways in which the exports and imports of Russia have taken place, we shall find that the exports of this country from places in the White Sea have increased 7½ times in the ten years; exports from parts in the Baltic have almost doubled, exports out of ports in the Black Sea have increased 2½ times, and exports by land almost 3 times. As regards the imports they have almost doubled through ports in the White Sea, through Baltic ports 2½ times, Black Sea ports double, and imports by land, 3½ times more than ten years since. The land-trade has, since Russia has had so many railways, considerably increased. The interior is now not only connected by railways with the ports on the Baltic and with the Prussian frontier, but also with the ports on the Black Sea; this of course has not failed to exercise an influence both on the more even distribution of trade and on the routes taken by commerce; however, it is an interesting observation that the imports and exports of Russia by the Baltic and its ports are not only the most important but that they steadily increase. Lastly, we give some idea of the channels through which the trade of 1871 was carried on last year between Russia and other nations. According to the customs' report, the following goods formed the principal exports of 1871: the value is given in silver roubles:—

	Roubles.
Corn	42,155,117
Flax	35,505,107
Linseed	13,822,020
Hemp	9,374,057
Wood-goods	6,518,695
Tallow	3,482,435
Bristles	5,424,900
Wool	1,275,505
Hemp yarn	1,029,227
Potash	1,008,629

The following goods were imported by the Baltic and its ports:—

Cotton	32,151,114
Metal	19,889,096
Tea	17,242,835
Dye stuffs	11,445,800
Machinery and tools	10,365,754
Metal iron manufactures	8,805,930
Wool	8,385,743
Cotton oil	7,681,283
Liquids	7,341,041
Coal	6,751,105
Woollen goods	4,012,955
Chemicals	3,636,635
Lamp oil	3,636,455
Coffee	3,318,060

Through the other channel, that is to say, through the ports in the Black Sea, the following were exported in 1871:—

Corn	112,656,556
Linseed	10,938,432
Wool	4,897,900
Butter	1,337,920
Tallow	1,154,695

The imports during the same were by way of the Black Sea:—

Metals	5,076,139
Fruit	4,851,781
Olive oil	3,711,071
Metal and iron manufactures	3,437,068
Liquids	269,143
Machinery and tools	1,746,010
Tobacco	1,580,829
Coffee	1,241,779
Tea	1,226,553

Finally exports overland for 1871 were as follows :—

	Roubles.
Corn	25,209,129
Flax	11,858,615
Wood-goods	6,266,464
Neat cattle	6,217,887
Bristles	4,404,800
Linseed	2,115,204
Wool	1,452,355

The inland imports for 1871 were :—

Cotton	13,296,479
Machinery and implements	8,097,897
Metals	6,191,639
Metal and iron manufactures	6,003,420
Wool	5,384,973
Woollen goods	5,150,426
Dye stuffs	4,408,921
Silk	4,116,074
Spun goods	3,614,408
Silk goods	3,252,605
Plants and seeds	3,152,456

THE IMPORTATION TO LONDON OF PREPARED FLOORING-BOARDS.

We see from the "Norsk Handelstidende" that the number of prepared flooring-boards brought into London from Norway were in—

	Number.
1869	3,340,000 pieces.
1870	3,815,000 „
1871	3,809,000 „
1872	3,892,000 „

NEW STEAM-BOAT COMMUNICATION.

From "Handels & Industri Tidning."

In consequence of the many complaints which have been lately made of the irregularity with which the traffic between Hull and Stockholm has been served by the English steamers on this line, the Stockholm Steam-Ship Owning Company have determined from the beginning of this season to keep up regular steam communication between Stockholm and Hull. Until two large steamers, now building for this trade, are ready, they will despatch two fine Swedish steamers, the "Bergsund," of 800 tons, Captain J. E. Morberg, and the "Helene," of 650 tons, Captain P. E. Blank, which will sail from Stockholm and Hull alternately, twice in the month.

It is reckoned that the first steamer will leave Hull next March.

CARLSBAD.

From "Handels & Industri Tidning."

A large new iron-works company has been lately formed, comprising Bofors, Gullspang and Skagersholms works, besides estates in Wermland, under the title of the Bofors and Gullspang Joint Stock Company. A Board of the Company, *pro tem.*, who are authorized to apply for a concession and draw up the articles, is formed of Mr. P. Lagerhjelm, of Bofors, the managing director, and Mr. C. F. Geijerstaam, of Ribbingsfors. The capital being already privately subscribed no subscription list will be laid before the public. The share capital is said to amount to 2,000,000 of riksdalers (£110,000).

The object of the Company is not to establish any new large works or to erect any large buildings. The coalition aims at a consolidation of the businesses, which will be carried on at the different places as nearly as possible the same as heretofore.

THE COMMERCIAL FLEET OF GOTHENBURG.

At the beginning of the year the commercial fleet of Gothenburg consisted of 171 ships, with a total of tonnage of 16,249 new lasts. Of these 122 are sailing vessels of 12,769 new lasts, and 49 steamers of 3,480 new lasts, with 2,508 horse-power. During last year the number of vessels was increased by 27, making 2,971 new lasts, 12 being new-built of 1,281 new lasts, and 15 purchased of 1,690 new lasts. In the year 1872, 7 Gothenburg vessels were lost, measuring 890 new lasts.

EXPORT OF DEAD MEAT.

From the "Stockholm Handels Tidning."

Proposals have been lately made for the formation of a Dead Meat Export Company, with 2,000 shares of 250 riksdalers each, or half a million riksdalers, with power to increase the capital to one million if required. The idea of this company seems to be, that instead of exporting live cattle, as has been hitherto done, the company shall sell both meat and articles manufactured from the same, and also sell cattle on commission. We have examined the calculations on which the company base their future operations, and as far as we have been able to find, the income is not taken too high. As regards expenses, too, we have certainly no wish to say that they are calculated too low, but it appears to us as if some expenses, which, in our opinion, are inseparable from the business, have been left out of the estimate. As, however, the actual profit has been considerably reduced in the calculation, that is to say, it has been calculated to turn out a great deal lower than the estimate shows, the above mistake, if it has been made, is by this more than made up. We must also acknowledge that we lack the knowledge of the trade, required just as much in this as in other lines, and that our judgment is of no use in the matter beyond what is possessed by every thinking and carnivorous being. The want of such a business has long been felt in our city, which, with its large population and with purchasers outside who probably amount to the same number, has only three slaughter-houses which we can take into consideration. The owners of these thus, in a certain way, possess a monopoly, and how they have availed themselves of the same our stomachs and purses could tell a tale. Their own freehold property says the rest. The company calls itself the Dead Meat Export Company, but we hope they will have the good sense to export as little as possible. It is quite as patriotic to eat good beef ourselves at reasonable prices as to content ourselves with dear and bad meat for the sake of letting our friends, the Englishmen, enjoy our meat at a low price.

COAL-MINING.

Stockholms Industri & Handels Tidning, February 4, 1873.

A Joint Stock Company of most respectable dimensions is being formed, the promoters being Count A. Taube, Messrs. C. Skogman, A. W. Dufva, Fischer, and Akrell, and the name of the company is to be "The Rönne Coal Company." It is stated in the prospectus that application has been made to the king to confirm the articles of association, that the share capital is divided into 18,000 shares of 500 riksdalers each, and that many subscriptions have already been received, so that only 7,000 shares will be offered, applications for which will be received to the 15th inst. As regards the yield, they reckon an output from twelve shafts of 2,160,000 tunnas, which at 50 öre per tunna gives 1,080,000 riks dalers, or 12 per cent. on 9,000,000 riksdalers. In this they do not calculate the result which may be expected from other business of the company ; as for instance the railway which is to connect the coal-fields with the sea, the harbour to be constructed at Skelderviken, the estates, and the manufacture of bricks or other articles from clay. The company will itself only work a fourth-part of the land acquired ; the rest will be divided into lots, and sold after the shafts have been opened, and the supplies of coal have been shown to be there. The extended prospectus also states the objects of the company, the prospects there are of the success of the undertaking, and the steps which the promoters consider suitable to bring it to a favourable issue. The undertaking is on a scale which renders it impossible for us to judge of it until we have had time to study the details. That the plan is good to turn to account if possible the stocks of coal, the presence of which one has no right to doubt, we have no wish to deny. Even if we grant that something ought to be done to find out for certain whether it is worth while to endeavour to raise coal-mining in this country to a great industry, we cannot however help looking on 9,000,000 of riksdalers as a very large amount to sacrifice for the bare trial. And a new company cannot bring about anything more than a trial. We will not mention that what has been hitherto done in this direction has not afforded us the least certainty that the earth in Skane contains any coal worth getting out. The trials which have hitherto been made, and the millions these experiments have cost, have not even made it probable that there is any coal that could compensate for the labour involved in raising and carrying it. The coal that has hitherto been raised has proved to be entirely unfit for the manufactures which especially use this fuel ; and however people have from time to time tried to put the best construction on the utterances which have fallen from men of science, they have not yet succeeded in getting from any one of them a written certificate stating that he has reasons, based on scientific grounds, to assume that they will eventually strike beds of coal comparable with those which are considered worth working in other countries. We have no idea of what the reasons may be which lead the promoters, under circumstances offering so little encouragement, to invite the public to risk so large a capital as 9,000,000 of riksdalers (£500,000), for it should be observed that when money is invested in mining, if the transactions perchance turn out wrong, an incomparably larger proportion of the cash is irrecoverably lost than in any other business. This business is so dangerous, that although sundry colliery owners in England and Saxony have several thousands per cent. coming in from

their money invested, it has been calculated that all coal-mines together, taking into account those only that are now being worked, do not yet pay interest on the money invested in them. And then it is to be observed that the greater number of these mines were opened under the guidance of the experience which had been gathered by others who had opened their mines under much the same circumstances, but such an experience is lacking in this country, and they have not had patience to wait for the time when the older companies would have placed this experience gratis at the disposal of the Rönne Company. This patience of which we speak would certainly not have been long tried, for it must soon be shown whether the millions expended in delving at Kropp and Bjuff have been thrown away or will yield any return. To pay 9,000,000 of riksdalers for this short time is to take a sanguine view of the readiness of the Money Market, which is for the moment well-supplied, to rid itself of the casual super-abundance, and does not speak much for any intelligent look into the future, when the enormous amount will be required for purposes of more certain realization. What we are opposed to is the speculative character of the project, and our opposition increases in proportion to the sums risked on one cast of the die.

We do not think that risky transactions should increase to a large branch of business, except where the formation of capital has gone on for so many centuries, and wealth has become distributed so equally and evenly, that it matters very little whether any capitalist, larger or smaller, risks what he is possessed of, or whether in fact a part of the capital disappears, but ours is not such a country; the formation of capital is so young, and the capital so small, that every loss is felt; this is the reason that we do not join in with the dirge of those who complain that the foreigners come here and rob us of our national wealth. Let us, in political respects, require from them all the guarantees we think necessary, but at the same time let us allow them in peace to give us their money, and in particular, let us leave to them the transactions which have rather the appearance of gambling than business.

Spitzbergen Expedition.

The following letter appeared in the "Tromso Stifts-tidende," 9th January:—

"According to the latest advices from Spitzbergen last autumn it appears that part of the crew of the ships frozen in at Spitzbergen in October have journeyed to Isfjorden to find shelter and preservation in the house erected by us there last summer. If they reach the said house they will be preserved from want; for there are large stores not only of provisions but also many other things which I have not seen noticed in the papers, and I will therefore here recapitulate the most important articles which are stored in the houses, as far as I remember. Although most people are aware that the house is sound and comfortable, I think it worth while to mention the conveniences there.

"On the ground-floor there are rooms 48 yards long and 6 yards wide, with stoves in good order, besides which there is a large loft with a kitchen and fire-place. Of fuel there are 200 to 300 barrels of coal mixed with coke and a few fathoms of wood; for light, about 800 cans of petroleum, one box of stearine candles, lamps and wicks; of meat there is more than enough for 18 men, there is no butter, but there are what can be used to eat instead, such as bacon, pork, cured mutton, and many barrels of salt meat. There is not enough bread, but there is a good deal of rye, and flour and compressed yeast, and potato flour; there are a good many grits and a good stock of whole and split peas, oatmeal and rice, and a lot of bags of salt. Further, a lot of preserved potatoes, a good deal of vegetables, coffee, tea, and chicory, 1 cask of treacle, 1 cask of vinegar, 1 small cask of lime-juice, cheese of various sorts, and a lot of dried fish; besides there is a good stock of delicacies, such as dried apples, currants, cherries, and various kinds of spices; there is also a little tobacco, there are 30 dressed sheep-skins, useful for bedding and overcoats, a good many reindeer-skins, oilskin clothes, woollen blankets, 2 bundles of homespun cloth, flannel shirts, stockings, and prepared leather. They need not remain without occupation, for they will find a stock of shoemaker's, tailor's, and carpenter's tools, and sundry tackle for hunting, including 5 rifles with ammunition, such as powder, lead, balls, cartridges, small shot and caps; fire-irons and all cooking implements and appliances are provided in abundance. There are a great many other things which are not stated here, but from what is stated, we may hope that the 18 men will find themselves well and cheerful without any essential privation, provided they have reached the establishment at Midthuken in good health. People keep writing to the papers that the crew of the "Onkle Adam," which also remained at Spitzbergen, had no provisions for the winter, but this is not the case, Captain Clase was with us with the "Onkle Adam" at Isfjorden when we were storing our things, and as he was very much afraid he should have to pass the winter there he bought provisions of us to the value of about 2,000 rigsdalers."

India via the Euphrates Valley.

WERE we able to adopt the principle employed by a celebrated Russian autocrat, we should, in planning a railway to our oriental dominions, place a straight ruler on the map, mark out a line reaching from London to Kurrachee, and adhere to it as closely as possible. The Russian had the great advantage, in putting his simple system into practical operation, of his proposed termini being in his own dominions. Independently of the absence of this incontestable advantage, in the present instance, there are other reasons which preclude the possibility of tracing out, in a manner so expeditious and so facile, the route of our future Indo-European railway. It will be, nevertheless, interesting to briefly sketch out the principal features of this orthographic high-road. Starting from Kurrachee, unquestionably the future port of India, if the harbour does not silt up—a contingency to which all harbours built on stereotyped principles are liable—the line almost immediately enters Belochistan. It traverses this *terra incognita* in a north-westerly direction, and after cutting off a corner of Affghanistan, reaches Persia. Keeping the same course, the line passes to the east of Yezd, which is celebrated for possessing the handsomest women in the dominions of the Shah. So noted is their beauty, that it is proverbial in the country that "to live happily, a man must have a wife of Yezd, eat the bread of Yezdeccas, and drink the wine of Shiraz." Leaving the neighbourhood of this Persian paradise, our high road runs within a few miles of the modern capital Teheran, and arrives at Reshd, where it just touches

"the sea-glass glittering o'er
The hills of crystal on the Caspian shore."

Thence it crosses the southernmost portion of the "land of Schamyl," within view of Ararat, and leaving to the left Trebizonde, the Eastern Hymettus, where the bees get intoxicated upon their own honey, reaches Poti, on the coast of the Black Sea. Here we meet with some traces of civilization. A railway already exists from Poti, on the Black Sea, to Tiflis, and is in course of extension to Baku, the corresponding port on the Caspian Sea. The line, after penetrating Circassia from the one end to the other, cuts through the Black Sea, touching, *en route*, the southern extremity of the Crimea, and lands us in Europe, near the mouth of the Danube, on the frontiers of Russia. The continuation of the straight road traverses Austria, passing eastward of Vienna, quits the continent north of Calais, and finally arrives at the city which the Americans facetiously term the "chief European village." The total length of this straight line from London to Kurrachee is about 3,630 miles, or 2,200 miles shorter than the route *viâ* Brindisi, Suez, and Aden, and 1,200 miles shorter than that *viâ* Brindisi and the Euphrates.

For the present there can be no doubt that this perfectly straight route is neither practicable nor desirable; but, bearing in mind the advantages in point of distance accruing from its adoption, any deviation from it has to be carefully considered. A glance at the map, as well as a knowledge of the "situation," to borrow an expressive term, are sufficient to point out that the deviation must be to the southward of the route already laid down. If a couple of straight lines be drawn, one from Constantinople to London, and the other from the former city to Kurrachee; the difference in the length of these two sides of the triangle, and that of the third or perfectly straight route, will be very trifling, not above 150 miles. It will be now seen, that this second route approaches considerably nearer than the first, to those which have been seriously proposed for effecting the purpose in question. In fact, one of the sides of the triangle that, extending from London to Constantinople, will certainly constitute a portion of the future Indo-European railway, whatever may be the direction of the remaining portion. It is a mere question of time. There is already railway communication existing along very nearly the whole distance to Constantinople. So soon as the missing link is completed, the adoption of it, as a part of the main route, will be a matter, to some extent, of national policy. The bridging of the Bosphorus presents no insuperable engineering difficulty, and there is the alternative of a tunnel if it did. Constantinople has for rather more than a century, formed the chief point of departure and return of all oriental travellers, and the following table, giving the routes

adopted at different periods, will have an appropriate bearing upon our subject :—

OVERLAND ROUTES.

Date.	Name.	Route.
1761-3	Niebuhr	From Constantinople, by Alexandria, Cairo, Suez, Locheia, Mocha to Bombay. From Bombay, by Bussorah, Bagdad, Mosul, Diabekir and Orsa, to Aleppo.
1777	Mr. Irving	From Bombay, through the straits of Babel-Mandel to Cosire, Genneh, and across the desert to Cairo and Alexandria.
1780-1	Mr. Irving	From Latichea to Aleppo, across the desert to Anna, Bagdad, Bussorah and Bombay.
1783	Mr. Foster	From Benares to Bareilly, Lucknow, Nhan, Sirinaghur, Cabul, Candahar, Herat, Balfrush, Baku and Astrakan.
1792	Mr. Campbell	From Alexandria to Latichea, Aleppo, Diarbekir, Mosul, Bagdad, Bussorah, and Bombay.
1797	Mr. Jackson	From Bombay by Bussorah, Bagdad, Mosul, Thies, Diarbekir, Sivas, Boli, and Scutari to Constantinople.
1808-9	Mr. Morier	From Bushire to Shiraz, Ispahan, Teheran, Tabrez, Erzeroum, Amasia, and Scutari to Constantinople.
1814	MajorKunneir	From Constantinople to Costambul, by Trebizond, Belis, Merdin, Nisbin, Mosul, Bagdad, Koot, and Bussorah to Bombay.
1817	Col. Johnson	From Bombay to Bushire, Ispahan, Teheran, Tiflis, Tchorkask, &c.
1817	Lieut. Hende	From Bombay, by Bussorah, Bagdad, Mosul, Diarbekir, Amasia, Boli, and Scutari to Constantinople.
1818	Lieut.-Colonel Fitzclarence.	From Bombay through the straits of Babel-mandel to Cosire, Genneh, Cairo, and Alexandria.

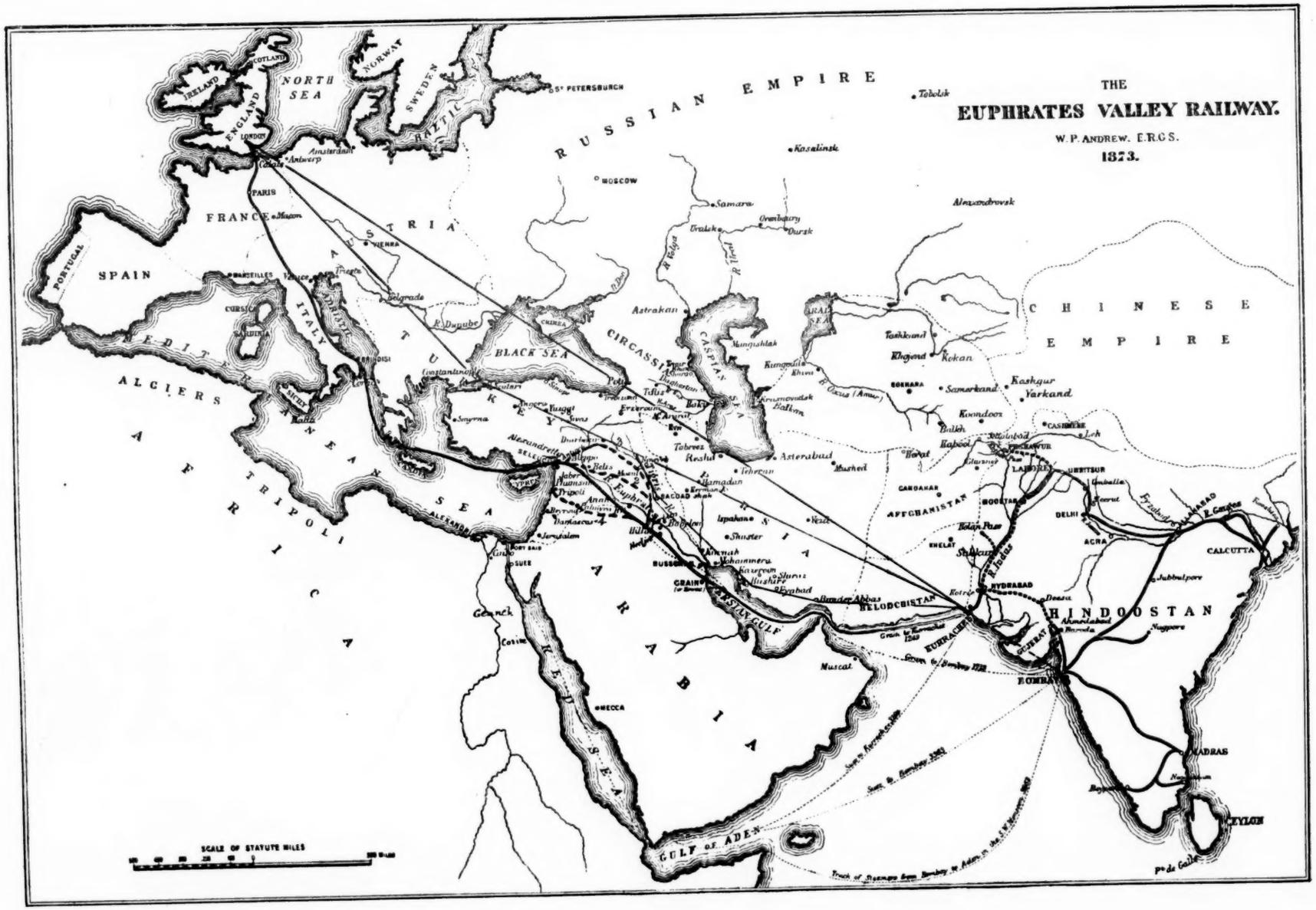
If we now compare these routes with the second marked out on the map, and forming the two sides of the triangles, it will be seen that the portion from Constantinople to Diarbekir has been frequently used by travellers, while the remaining part from that place to Kurrachee or Bombay has not. Let this latter part be abandoned, and lines drawn from Nineveh to Bagdad, from Bagdad to Bushire, then along the Belochistan coast to Kurrachee. This will give a very close approximation to the probable future inland Indo-European railway, the length of which is about 3,850 miles, or a thousand miles shorter than the shortest route proposed, which passes through the valley of the Euphrates. The construction of this great inland high road will be a work of very considerable time, and one for which as a nation we certainly ought not to wait. The important point to discover is the part of this line which it behoves us to construct, which we could use in conjunction with transport by sea. This is, as the map will point out, the section connecting the Mediterranean sea and the Persian gulf. The question of the exact routes which a railway connecting these two seas should follow, has been canvassed in all its bearings, and has practically resolved itself into one of two, known respectively as the Tigris and the Euphrates line ; since at whatever points on the Mediterranean sea and the Persian Gulf the termini may be situated, the main line will run down the valley of one or other of these two great rivers. Of the various routes which were proposed before a select committee, appointed last year to examine and report upon the whole subject of railway communication between the Mediterranean, the Black Sea, and the Persian Gulf, the following five were considered to deserve consideration. (1.) A line starting from Alexandretta or from Suedia near the mouth of the Orontes, passing through Aleppo to the Euphrates, at or near Gaber Castle, and thence down the right bank of the river to Grain, on the western side of the Persian Gulf. (2.) A line starting from one of the same points, marked 2 on the map and shown by dots, crossing the Euphrates at Belis, passing down the left bank of the river, or the right bank of the Tigris, to a point nearly opposite Bagdad, recrossing the Euphrates and proceeding to Grain. (3.) A line starting as before, 3 on the map, crossing the Euphrates at Bir, thence going round to Orfah and Diarbekir, and following the right bank of the Tigris to Bagdad, whence it would follow line 2. (4.) A line somewhat like the last-mentioned, but following the left instead of the right bank of the Tigris. (5.) A line starting from Tripoli and proceeding across the desert, by way of Damascus and Palmyra to the Euphrates, whence it might follow either of the Euphrates' routes. Of these routes, 2, 3, and 4, necessitate the construction of a couple of bridges over the Euphrates or the Tigris, structures, which from the magnitude of the rivers, would be formidable items in the estimates. Besides it is bad engineering to cross and recross a river unless there is some unavoidable reason for it. There remain therefore lines 1 and 5, both of which do not cross either of the rivers, and have a considerable portion of their routes in common. The difference consists principally in the port selected for the commencement of these lines on the Mediterranean coast, Alexandretta being that of the former and Tripoli of the latter. Alexandretta already possesses an excellent natural harbour, but this advantage is counterbalanced by the alleged unhealthiness of the place. This signifies nothing more, than that the sanitary arrangements of the town and neighbourhood, are in the normal condition prevailing in semi-civilized countries. A good system of drainage, and the adoption of stringent sanitary measures, would soon render the place safe and habitable by Europeans. With respect to Tripoli, the evidence given before the committee was not of a character sufficiently tangible, to warrant any preference being given to it over the port of Alexandretta.

So far, therefore, as the Euphrates valley route is concerned, there is very little doubt, that the course shown on the map by the thick black line is the one to be preferred. This is the route proposed by Mr. W. P. Andrew, who is probably, since the death of General Chesney, the first authority in the matter. To a valuable paper read by him last year before the British Association, we are indebted for much of our information on the subject, and the accompanying map. The question, therefore, becomes reduced, as we have already stated, to a consideration of the relative merits of the Tigris and Euphrates routes. As will be seen on the map, the former constitutes a portion of the ultimate Indo-European railway, whilst the latter does not. It therefore loses whatever advantages may be supposed to belong to that route. These may be briefly summed up, as in the first instance, of an altogether prospective character, and secondly, as promoting the interests of Turkey a great deal more than our own. With regard to the traffic that may be expected to accrue from the adoption of this route, we are inclined to consider it has been very much exaggerated. The fact appears to be lost sight of, that an amount of traffic which seems very considerable, when the means of transporting it are imperfect and inadequate, dwindles into comparative insignificance when it is provided for by an able manager, backed up by a staff of competent officials and abundant *matériel.* Whichever line may be adopted, the difficulty of dealing with the nomad tribes, through whose territories it must pass, may be regarded as common to both. We do not accept the philanthropic assurance put forward by some, that these savages are amenable to the laws and customs of civilized nations ; neither do we put much faith in the hope of converting to civilization, wandering tribes whose code of morality has an infinite range of elasticity, whose livelihood is strife, and whose trade is plunder. The only effectual plan of dealing with such people is the American. There can be no doubt that, viewing the enterprise solely from an English point of view, the route by the Euphrates valley, as laid down by Mr. Andrew, is the one to adopt. It is much shorter, would be easier and cheaper to make, and assuming an equal rate of speed, would enable a quicker passage to be made than by the Tigris valley. If we make the line ourselves, unaided by any foreign government, as is most probable, if it be made at all, we have no other interests to consult than our own. The shortest, safest, and quickest passage to India is what we urgently require, and this we can obtain by the Euphrates valley line. The connecting links may be riveted in afterwards. Branches can be made subsequently throughout the fertile region of Mesopotamia, the cradle of the human race. There is no immediate necessity for the locomotive to awaken the echoes in the capital of the Chaldean empire, to run its iron course through the ruins of Nineveh, or for its shrieking whistle to resound

> " By Bagdad's shrines of fretted gold,
> High-wall'd gardens green and old—"

But there may be at any moment immediate necessity for despatching, as quickly as possible, an armed force to Delhi, and for placing troops at Peshawur, or at any other point of our northern frontier line, to guard our vast oriental dominions. Until the Euphrates route is available for this purpose, it cannot be said that we have availed ourselves to the utmost of the means at our command for facilitating our communication with India. Whatever may be the ultimate high road between east and west, this much can be, and ought to be done at once.

The real difficulty in the way of the construction of the Euphrates valley railway is the inability to raise the funds, not on account of the actual magnitude of the amount required, although £10,000,000 is a good round sum even in these days of


THE
EUPHRATES VALLEY RAILWAY.
W. P. ANDREW. F.R.G.S.
1873.
RUSSIAN EMPIRE
CHINESE EMPIRE
HINDOOSTAN
ARABIA
PERSIA
TURKEY
AUSTRIA
FRANCE
SPAIN
PORTUGAL
ITALY
ENGLAND
IRELAND
SCOTLAND
NORTH SEA
SWEDEN
NORWAY
BALTIC SEA
BLACK SEA
CASPIAN SEA
ARAL SEA
MEDITERRANEAN SEA
ALGIERS
TRIPOLI
AFFGHANISTAN
BELOOCHISTAN
PERSIAN GULF
GULF of ADEN
RED SEA
ARABIAN SEA
St. PETERSBURGH
MOSCOW
PARIS
LONDON
VIENNA
CONSTANTINOPLE
BAGDAD
BOMBAY
MADRAS
CALCUTTA
DELHI
AGRA
CEYLON
SCALE OF STATUTE MILES

"milliards." But the truth is, that the line, for some years at least, could not possibly pay; and moreover, unfortunately, no attempt has been made by those anxious to promote it, to show, in a tangible and reliable manner, what returns might be fairly expected. £10,000 per mile is not by any means an extravagant sum for the making of a railway, even when the land is obtained for nothing; but shareholders require some guarantee for their investments and dividends, more solid than the anticipated results of the conversion of wandering Arabs, or the speculations of honest but mistaken biblical archæologists. Locomotive transport cannot be supported by the relics of departed kingdoms, or the ruins of decayed cities. It cannot be denied that the committee last year, arrived at a perfectly accurate conclusion respecting the financial portion of this great undertaking, when they decided that there was little or no probability of it being carried out solely by private enterprise. The interference and the aid of the government, either alone or in conjunction with that of the Ottoman empire, is indispensable to the future prosecution of the scheme. It is then questionable whether the proposed rate of interest, four per cent., and one per cent. for a sinking fund, would be a sufficient inducement to capitalists to risk their money. Government guarantees of five and six per cent. have been given upon undertakings not possessing so much national importance as the one under consideration. A reference to the map will show that the route proposed by Mr. Andrew, and marked out by the thick black line, leaves Europe from the port of Brindisi—a place which is destined to restore the glories of the Adriatic, and bring again to its waters the merchandise of the eastern world. The annexed table will show the relative distances of the several portions of the different routes, as well as their total lengths:—

Distances in statute miles *viâ* Brindisi and the Euphrates Valley.

	Miles.
London to Brindisi	1,465
Brindisi to Alexandretta	1,189
Alexandretta to Grain	920
Grain to Bombay	1,713
London to Bombay	5,827
Grain to Kurrachee	1,249
London to Kurrachee	4,823

Distances in statute miles *viâ* Brindisi, Suez, and Aden.

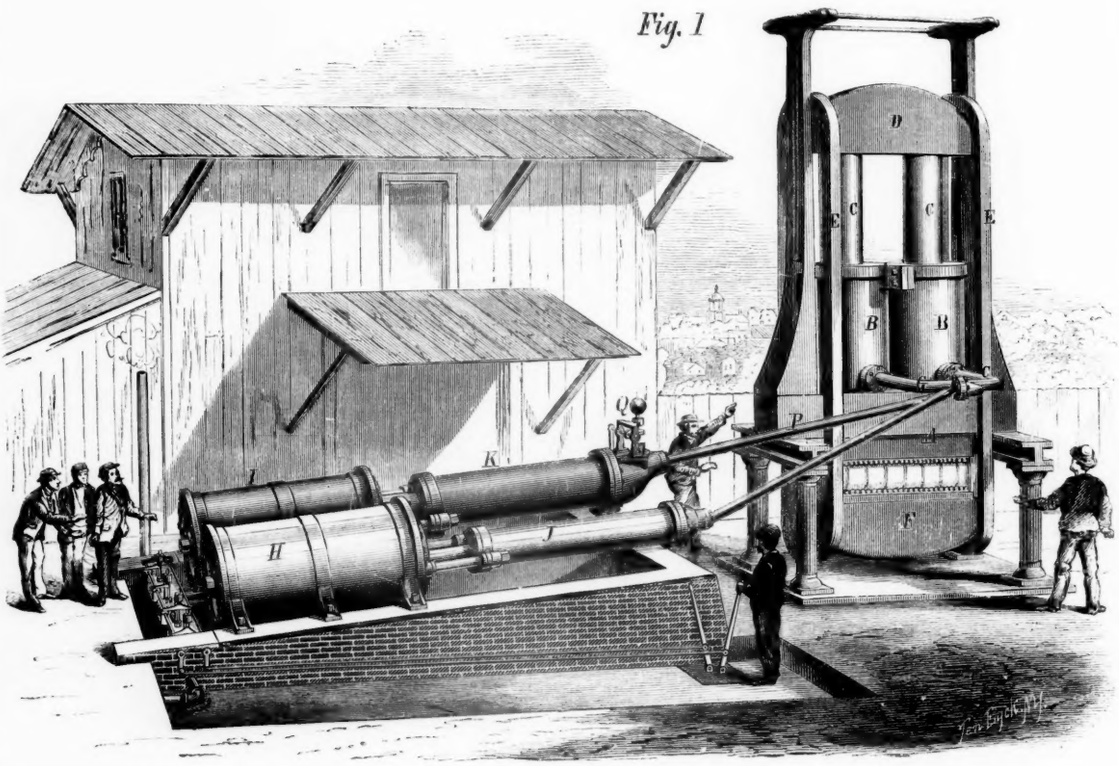
	Miles.
London to Bombay	6,012
London to Kurrachee	5,843
Saving in favour of Bombay *viâ* Euphrates Valley route	725
Saving in favour of Kurrachee *viâ* Euphrates Valley route	1,020

A very excellent authority on matters connected with railroads, Captain Tyler, R.E., one of the inspecting officers of the Board of Trade, considers that the saving of distance by the Euphrates route from London *viâ* Brindisi and Scanderoon to Bombay, as compared with that *viâ* Brindisi, Alexandria, and Suez, at 723 miles; and he estimates the saving of time at 92 hours. The adoption of Kurrachee as the Indian port, instead of Bombay, would increase the saving, and also facilitate the passage during the monsoons, by avoiding the navigation of the Indian Ocean. Independently of the many reasons which have been advanced for the construction of this railway, there is one which deserves especial attention. It is the possibility that if we do not take possession of the route ourselves, another power may do so; and as Mr. Andrew very justly remarks, "we shall speedily find that the shortest, easiest, and safest route to our eastern possessions has fallen into the hands of our most powerful rival for commercial and political ascendancy in the east." Precaution does not necessarily imply the existence of danger, nor is a prudent man always an alarmist.

DIRECT ACTING STEAM AND HYDROSTATIC PRESS.

THE "Scientific American" reports:—A valuable and ingenious application of steam to the hydrostatic press is illustrated in the accompanying engravings. The power is transmitted to the oil, water, or other liquid in the press from the pistons of two steam cylinders, which act upon the platen alternately, one imparting the initial and the other

Fig. 1

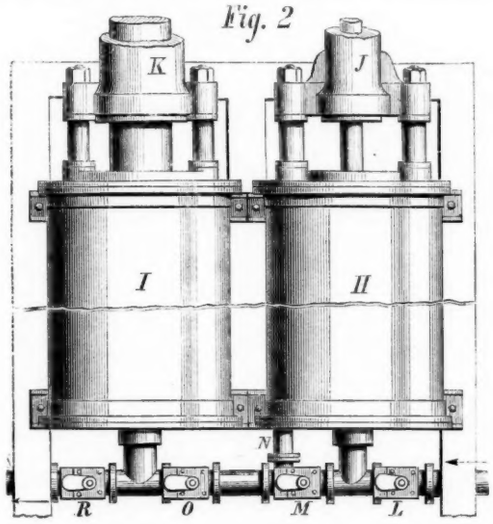


the finishing pressure. The latter is operated by live steam from the boiler, and the former is actuated by the exhaust. The steam is thus used twice over, on the compound principle, effecting no inconsiderable saving of fuel.

Our large engraving, Fig. 1, represents the entire apparatus set up and in action. Fig. 2 shows the steam cylinders in plan, broken to exhibit the attachment, and Fig. 3 a section of the check valve. A, Fig. 1, is the hydrostatic press, adapted for pressing cotton or other substances. B B are hollow cylinders inclosing the solid rams, C C, which, communicating with the cross-head, D, raise the links, E E, and consequently the platen, F; G G are branched pipes through which the liquid enters the cylinders, B B. H and I, Figs. 1 and 2, are the steam cylinders, equal in size. J and K are chambers in which work the solid plungers which, at the same time, are the piston rods of the cylinders, H and I. The plunger in J, it will be noticed, is much smaller in diameter than that in the chamber, K.

Previous to the pressing operation, live steam is admitted (in the direction of the arrow, on the right of Fig. 2) which, the

Fig. 2

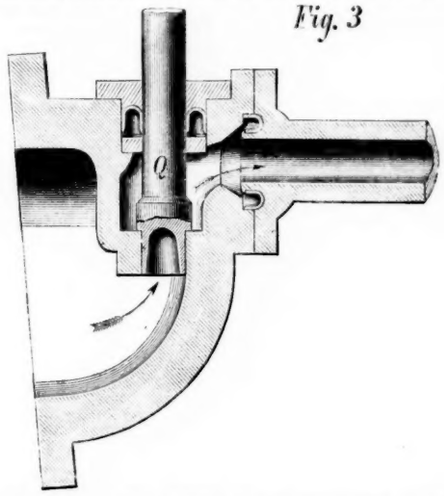


valve, L, being open, enters the cylinder, H, and forces the piston ahead against the pressure of the liquid which is contained in the press cylinders, B B, the chamber, J, and one of the connecting pipes, P. The valve, L, is then closed, steam pressure is thus cut off, and the piston, acted upon by the liquid pressure, returns to the rear of the cylinder, forcing out the steam contained therein. Meanwhile the valve, M, is opened, and the steam, having no other exit, passes through the same and into the pipe connecting the valve chambers of the two cylinders. As the inlet valve, O, of the second cylinder is closed, the steam enters the pipe, N, and is thereby reconducted into the cylinder, H, the said pipe passing along the outside of the cylinder to its front end, when it communicates therewith, and the steam fills the whole space in front of the piston. The object of the proceeding is to thoroughly warm the cylinder, H, so that it may less condense the live steam that is subsequently admitted into it.

In commencing the pressing, the valve, O, is first opened. The steam, which we have above alluded to as having entered in front of the piston in the cylinder, H, now returns through the pipe, N, and becomes the motive steam in the cylinder, I, continuing to flow from one cylinder to the other, until the pressure on the two pistons is equalized. The valve, O, then closes by its own weight, and any steam which may remain in front of the piston, in cylinder H, may be allowed to escape through a pipe (not shown) in connection with the exhaust, S. The steam, entering through O, pushes forward the piston in cylinder, I, and the ram in chamber, K, thus displacing the fluid, forcing it underneath the rams, C C, and thereby lifting the platen, F. As soon as the motion of the piston stops, either by its reaching the end of its cylinder, or being arrested by the opposition of the liquid, a check valve, Q, at the front end of chamber, K, which has been opened by the passage of the fluid as it is forced through, closes automatically by its own weight, thus preventing a return of the current. The arrangement of this valve with the forward portion of its containing chamber is clearly shown in section in Fig. 3.

The valve, L, is next opened, and live steam admitted to the piston, in cylinder H, which, by means of the ram in J, drives a second current through its connecting pipe of the pair, P, under the rams, C C, and so completes the pressure of the material between the platens. The bale being properly tied, the valve, L, is closed, and the valve, M, opened. The weight of the platen acting on the liquid forces the piston in cylinder, H, back, the steam in the rear of the latter once more passes by the tube, N, to the front, and the operation, as already explained, is repeated. The various valves alluded to are governed by convenient and suitable mechanism, which need not here be described, and are controlled by the hand levers, as shown in the large illustration. The initial pressure upon the platen not requiring so great an application of power as the finishing pressure, it is evident that, by the increased diameter of the ram, K, and the reduced action of the exhaust steam, a quicker though less effective force is obtained. But the ram, J, being of smaller sectional area, and receiving also the full force of the live steam,

Fig. 3



is, as may be mathematically shown, necessarily capable of exerting an enormous pressure. Moreover, this ram is constructed less in diameter than the press rams, C C, in order that the pressure upon the latter may be in proportion as their diameters are the greater. It is evident, therefore, that this portion of the invention is excellently devised for imparting the concluding powerful impulse to the platen.

The inventor informs us that two of these presses are in operation in Charleston, S. C. One having two rams, each 16 inches in diameter and 44 inches travel, steam cylinders of 48 inches, and stroke 7 feet, with 86 pounds of steam, gives a pressure of 1,200,000 pounds on the material in the press, or 14,117 pounds for every pound of steam. The other, with 22 inch rams, 56-inch cylinders, and 8-feet stroke, with 80 pounds of steam, affords 2,138,640 pounds pressure, or 26,733 pounds per pound of steam. The operation of these machines is stated to be in every way satisfactory.

For further information, address the patentees, Messrs. John F. Taylor and Co., Phœnix Iron Works, Charleston, S. C.

THE HENDERSON DOUBLE SCREW.—Thomas Henderson, the senior partner of the firm of Henderson Brothers, proprietors of the Anchor Line, has recently patented an improvement in screw steamers, which, he claims, gives additional security to life and property. It consists in providing a screw steamer with two propellers, one of which is of the ordinary relative dimensions, as placed in the usual position of the ordinary propeller, the other being smaller, and placed directly in front of the ordinary one, and below its shaft. The two shafts may be connected to one set of engines, or to separate engines. When only one set of engines is used, the main shaft may be connected to the smaller shaft by spur gearing, provided with coupling appliances, admitting of their being connected or disconnected at pleasure. The propellers can be driven in opposite directions if desired. It is claimed that, for manœuvring in narrow waters, or handling war vessels, that it will be found of great value; or when, by reason of loss of masts and sails, the vessel is solely dependent upon steam propulsion, she has in her double screw all the elements of speed and safety still left. This system has just been patented here, and in due time we are to be shown a practical working of Mr. Henderson's system.—*Nautical Gazette, New York.*

THE PRACTICAL NOTE-BOOK OF TECHNICAL INFORMATION USEFUL TO STUDENTS AND WORKMEN.

(19.)

DESIGNS for Ornamental Wood-work, and Working Lines and Centres.—In notes Nos. 4 and 6 we have given several designs; we now continue the series. In fig. 80 we give a design for a double eaves board (for a single board see fig. 20, p. 30, under note No. 4). In this the height *b c* is divided into 17 equal parts, one of which gives the diameter of the circle *a*, which may be considered as the element or standard of all the measurements of the design. The centre *d* is found by setting off the diameter of *a* from *c* to *d*; the diameter of the part of the circle described from being equal to twice that of *a*. Three times the diameter of *a* are set off from *c* to *i*, and a line drawn through the point at right angles to *b c*. On this line the centres *b* and *g* are placed; the distance of these from point *i* being equal to one and a half times of *a*. The point *j* is this distance from *i*, and in a line at right angles to *b c*, drawn through it, a line on which the centres *k* and *l* are situated; the diameter of the circle of which the arcs form a part being equal to those of the circles described from *g* and *h*; the arcs touching each other. From *l*, the centre of the arc *m n*, a distance equal to the radius of *a* is set off on *k l* to *m*, and through this, parallel to *b c*, a line *m n* is drawn; from *m* set off the diameter of *a* to *n*; *n* is the centre of the arc *o*. The other parts of the design are put in from the centres and lines shown. In fig. 81 the point *b* is the centre of the design, which is for a balcony or other railing. The distance from *b* to *a*, the upper terminating line of the rail, is divided into eight equal parts, three of which are set off from point *b* to the points *c* and *e*, and three from points *c* and *e* to the points *d* and *f*. Through these points lines are drawn at right angles to the line *a b*, and upon these horizontal lines the centres of the various circles and arcs of circles are found, and from these the other centres and distances are found in turn. The diameter of the circles described from the points *g* and *h* is equal to one of the parts into which *b a* is divided, and this diameter is the element or standard of all the circles and arcs of circles, the radii of all these being indicated by dotted lines. Fig. 82 is a design for a simple form of railing or paling.

Fig. 83 is a design for a bracket of a simple, and fig. 84 for a bracket of a more complex character. Let *a b*, fig. 83, be the height of the bracket, three feet being full size. Divide *a b* into three equal parts; through the first of these, from *b*, draw the line 1 *c* at right angles to *a b*; make *a d* in depth equal to one half of *b* 1, and draw *d e* parallel to 1 *c*. With distances *b* 2, set off from *d* to *f*, divide *b* 1 into three equal parts, and from 1 set off one of these on the line 1 *c* to *g*; and with same distance from *g* to *h*; these points being obtained by means of the centre lines be able to complete the drawing.

Fig. 85 is a design for a "kiosk," or "garden house," in which the application of ornamental cut wood-work is exemplified. Such structures afford great scope for the cut-wood designer, and it has been our good fortune to see several of them on the Continent of most beautiful design, and of which the details were most chastely appropriate. The student in design, by way of practice, should draw several outlines showing the general plan of the arrangement of the structure, and thereafter draw portions to a larger scale, applying the designs for such ornamental work as we have already given, which would seem to him most appropriate for the general design of the structure. There is wide scope in this country for erections of this kind, both for public and private gardens and parks, and we propose, from time to time, to give designs suggestive both of arrangement and of the ornamentation.

(20). **The Geometrical Solids, and their application to Working Drawings in the Constructive Arts.**—In notes Nos. 1 and 7, we have given a series of diagrams illustrative of the cylinder, its sections and development, we now take up the *Cone*; illustrating it in like manner. The sections and the development of the surfaces of cones are useful to the mechanic in all constructions relating to splayed or bevelled arch heads of windows, the finding of the surface of conical roofs, and other practically useful purposes. The cone is a round solid body, the base of which is a circle, the sides slanting or converging to a point called the apex of the cone. Upon its sections are founded a very great number of forms of solids, and problems by which those forms are projected. If a cone is cut by a line at right angles to the base, and passing through the apex and centre of base, the section is a "triangle;" if cut by a line parallel to its base, and cutting both of the sides; the section is a "circle;" if cut by a line oblique to the base, and cutting both sides, the section is an "ellipse;" if cut by a line parallel to one of its sides, and cutting one of its sides and the base, the section is a "parabola;" if the cone is cut by a line which cuts only one of its slanting sides, the section is a "hyperbola."

(*a.*) A cone may be produced in cardboard as shown in fig. 86. Let *a* be the circle of the base; through *b*, its centre, draw a line, *b c*; make *e c* equal to the length of the sloping sides; from *c*, with *c e*, describe the arc *f c g*; take in inches, or in parts of inches, the radius, *b e*, of the base, and multiply by 180°, and divide it by the number of parts there are in *c e*, the length of the slanting side; the result is the angle which the sloping side, as *c g*, makes with the centre line, *c b*. In the example there are two parts in the radius *b c*, and six in the length of side, which gives the angle, *e c g*, of 60°. From *c*, with a chord of 60°, describe the arc, *c b*, and set off 60° from the same scale of chords from *e* to *g*; draw *c g*, and make *e f* equal to *c g*, join *c f*. Then cut out, with a sharp knife, the outline *e f*, *c g e*, and the circle *c a b*; bend round the part, *e f*, *c g e*, till the edges *c f*, *c g* meet, the edge *f c g*, passing round the periphery of the circle *a*, the cone will be completed.

(*b.*) *To find the section of a Cone cut by a line oblique to its base.* (Fig. 87).—Let *a b c* be the given cone, and *d e* the cutting line. Divide the base line, *a b*, into two equal parts in the point *f*, and draw *f c* perpendicular to the base line *a b*. Draw any number of lines parallel to the base *a b*, as *e g*, *h i*, *j k*, and so on. From the points where these intersect the side *a c* of the cone, as *g i k m*, &c., drop perpendicular lines, cutting *f a* in the points 1, 2, 3, 4, &c., and from the points, *n l*, *j h*, other perpendicular lines, as in the diagram. From *f* as a centre, with *f* 1 as radius, describe the semicircle 1, 7. With *f* 3 as a radius, the semicircle *f* 8; with *f* 4, the 4 9; with *f* 5, the semicircle 6, 5; and with *f* 10, 10, 11. Then from the point *v*, where the semicircle *f* 8 cuts the line dropped from *h* measure to 8, and set off this distance *v* 8; on a line, *h a'*, drawn at right angles to the cutting line *e d*, the distance *h a'*, equal to *v* 8. Next, from the point *w*, where the circle 4 9 cuts the perpendicular 9 *j*, measure to 9, and set off this distance from *j* to b', on the line *j* b^1 at right angles to *d e*. In like manner set off the distance *x* 5, from *l* to c^1, and *y* 11, from *n* to d'; a curve drawn by hand, or carried through the points d' c^1 b' *d'* will give one-fourth of the ellipse; and the remainder of the ellipse will be found as described in connection with fig. 3, note No. 1, p. 26.

(*c.*) *To find the Development or the covering Surface of part of a Cone, fig.* 88—Let *a b c d* be the portion of the cone to be covered; the sides *a b*, *d c*, being produced to *e* to complete the cone. Divide the base *a d* into two equal parts in point *f*, and draw *f e* at right angles to *a d*. With radius *f a*, from *f* describe a semicircle *a b d*. Divide this into any number of equal parts, as twelve. From *e* as a centre, with *e a* as radius, describe an arc *a g*; and with *e b*, another arc *b h*; and set off from *a* on the arc *a g*, the same number of equal parts as *a* 6 *d* is divided into, the last of these terminating at 12. From *e*, through each of these points draw lines as in the drawing; and also from the points in *a* 6 *d*, obtained by drawing the ordinates as 4 *i* parallel to 6 *f e*. Then the part *a* 12 *j b* is the "stretch-out" required, which, when cut out will be found to cover the surface *a b c d* of part of the cone. This covering may be supposed to be made up of a number of boards, as shown by the crossed lined parts at 12 *j*.

(*d.*) *To Develope the surface, or find the "Stretch-out" for part of a Cone of the form given in fig.* 89.—Let *a b c d* be the parts of the cone to be covered, and the sides *a b*, *d c* produced to *e* to complete the cone. Divide *a d* in the point *f* into two equal parts, and from *f* with *f a* describe the semicircle *a* 6 *d*. Divide this with any number of equal parts, as twelve, and from these points on *a* 6 *d* draw ordinates, cutting the base line *a d* of the cone in the points as *h*, *j*, &c., &c. From these points draw lines to the vertex or apex of the cone, cutting the line *b c* in the points *i k m*, &c. From these at right angles to *c b*, draw lines as *k l*, *i h*, *m n*, &c. From the point *e*, with radius *e a*, describe the arc *e a g*, and from *a* set off towards *g* the same number of equal parts as the semi-circle *a b d* is divided into, terminating in the point 12. From the points on the arc *a* 12, draw lines to the point *e*. Then from 12 in *a g*, measure to the point *p*, making 12 *p* equal to *c o*, the first of the perpendicular lines drawn from the points on the line *c b*; in like manner set off from the points 11, 10, and 9, on *a g*, the distances obtained from line *b c*, thus the distance 7 *t* is equal to *m n*; the distance 5 *s* equal to *i h*; and 4 *r* to *k l*, and so on. Then, through the points thus obtained, as *p t s*

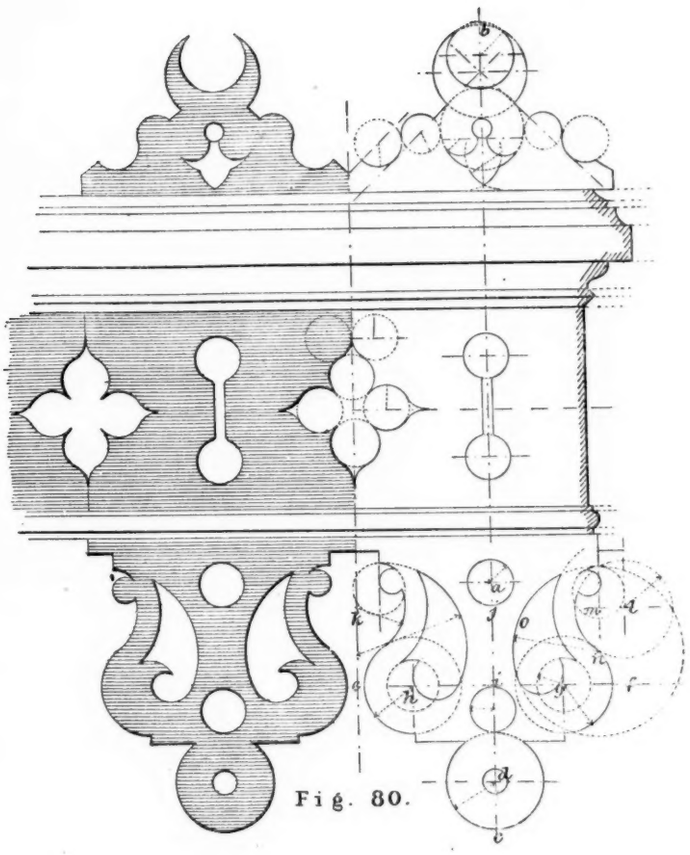


Fig. 80.

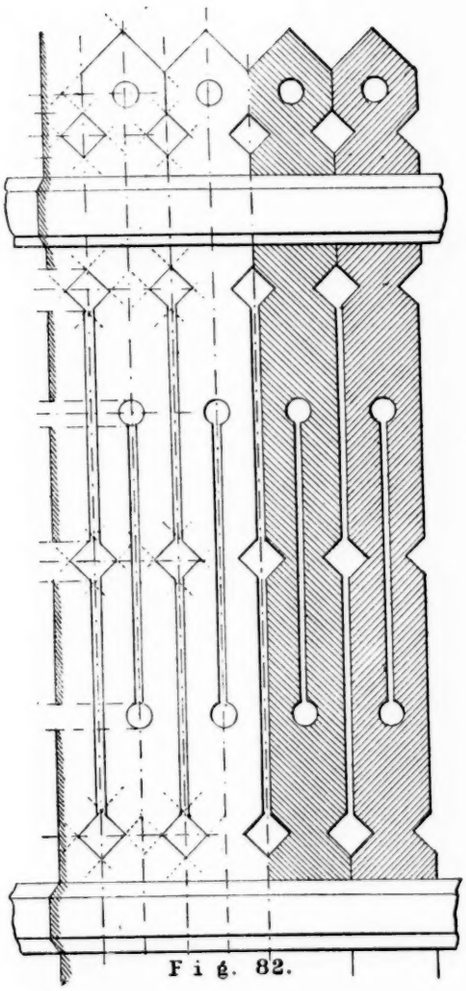
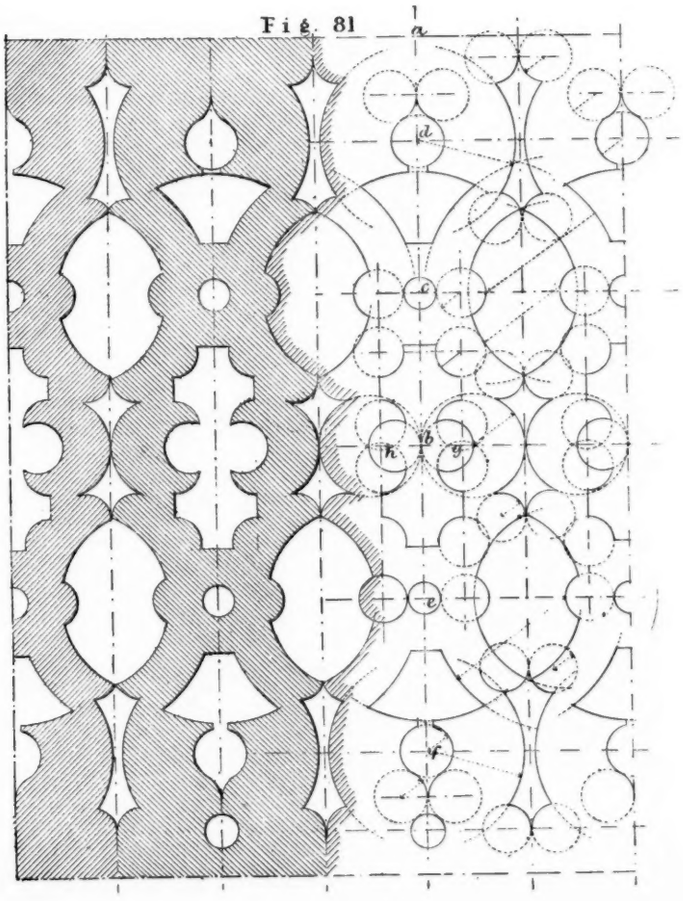


Fig. 82.

Fig. 81



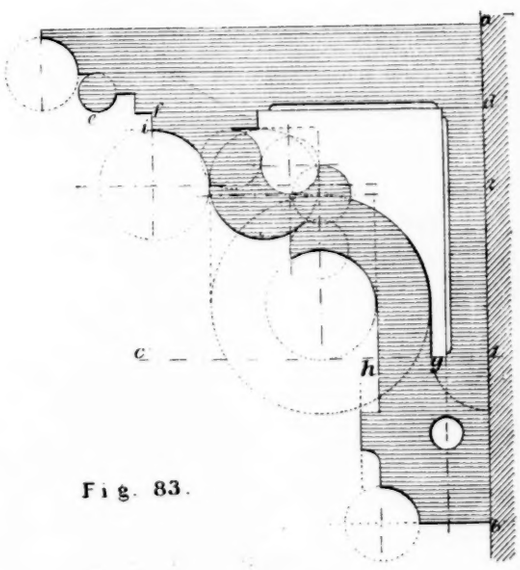


Fig. 83.

r, draw a curve by hand, and the part *a* 12 *p b* will be the "stretch-out," which, when cut will cover the part of the cone

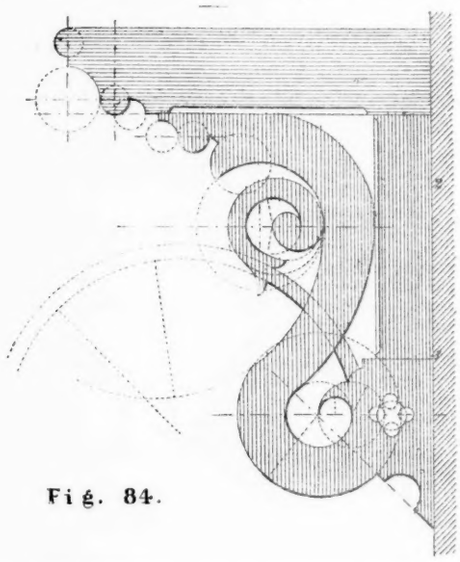


Fig. 84.

a b c d. The "stretch-out" may be considered as made up of a number of boards, as 12 *p*, 11 *w*, 10 *v*.

(21.) **Memoranda on Cast-Iron.**—In continuation of note, No. 15, p. 134, we now give in tabular form, information

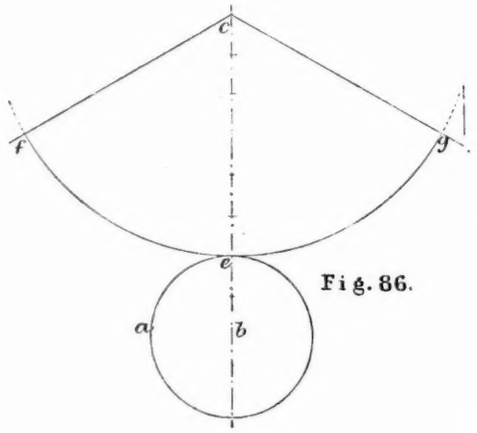
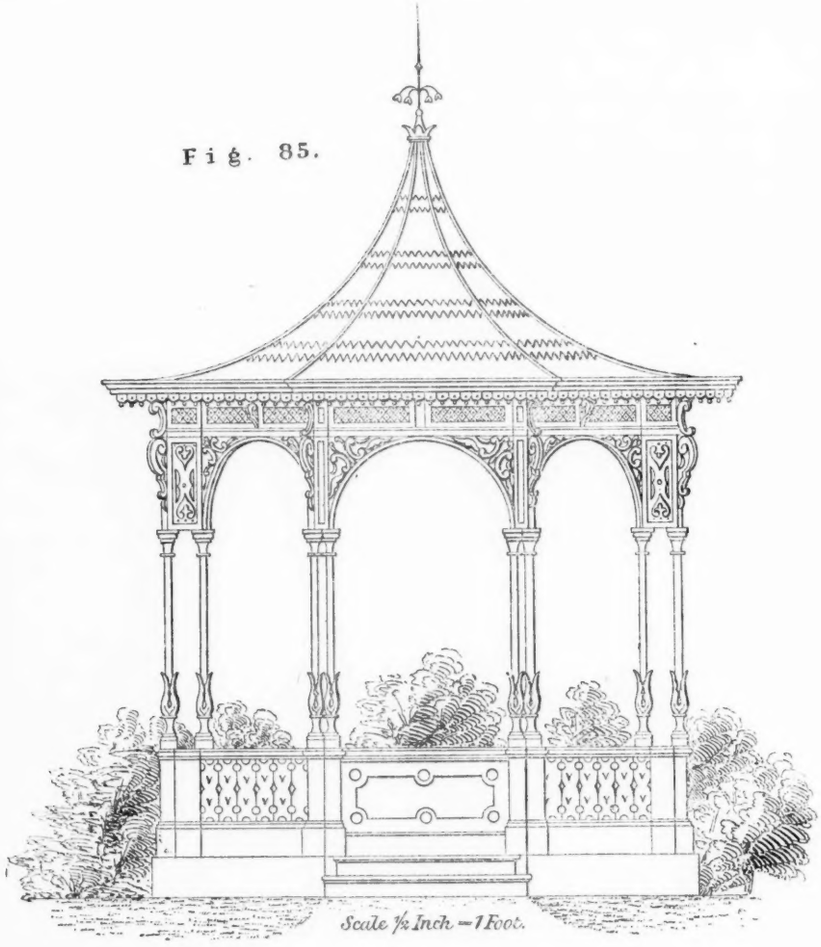


Fig. 86.

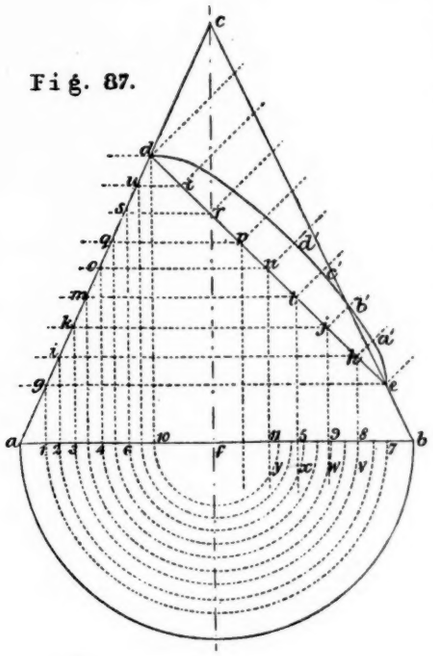
on the specific gravities, strength, &c., &c., of cast-iron, recording the valuable experiments instituted by Mr. Hodgkinson and Sir William Fairbairn.

Fig. 85.



Scale ½ Inch = 1 Foot.

Fig. 87.



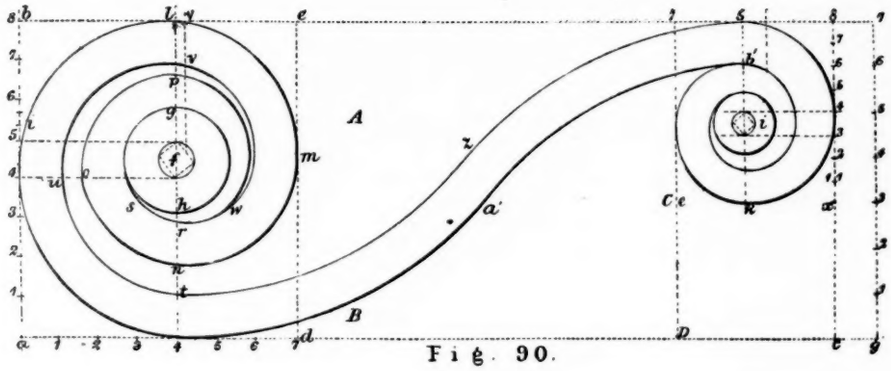


Fig. 90.

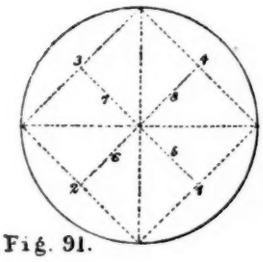
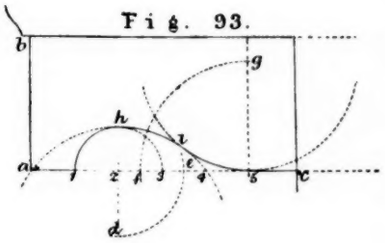


Fig. 91.

Fig. 93.



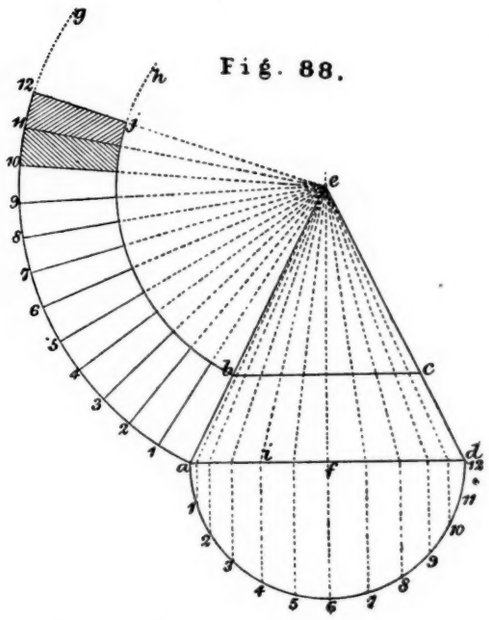
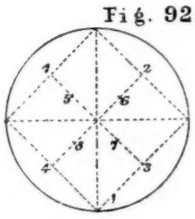


Fig. 88.

Fig. 92.



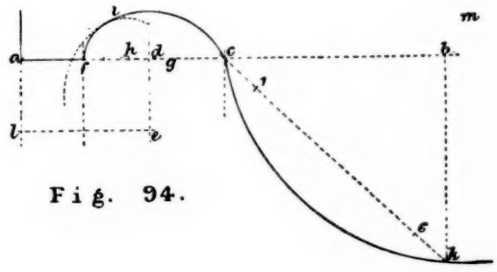


Fig. 94.

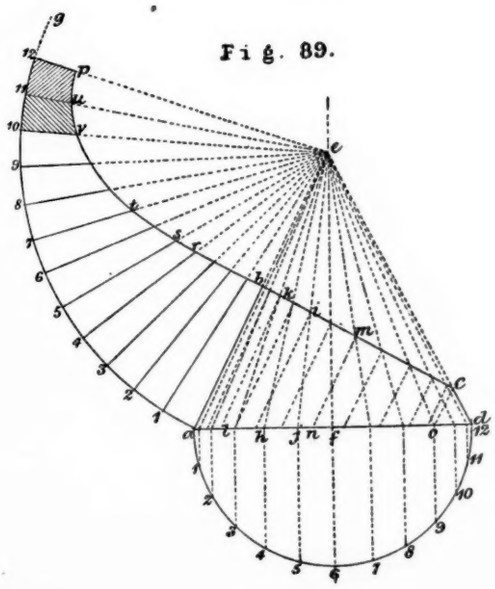


Fig. 89.

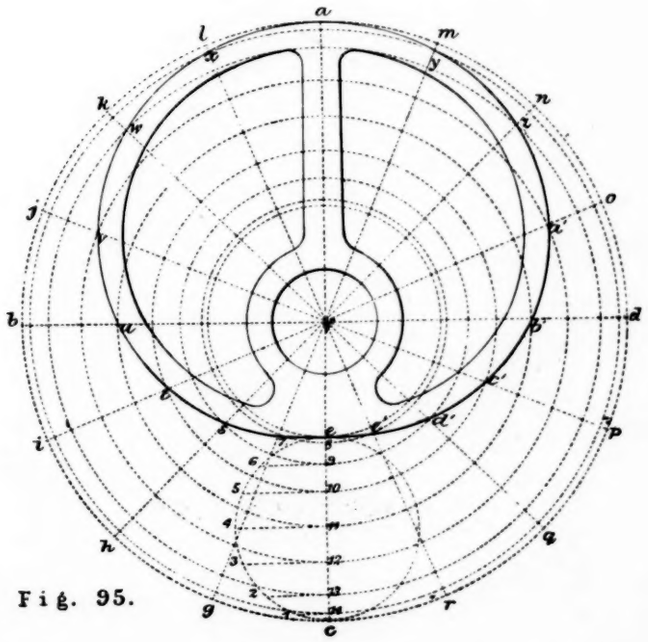


Fig. 95.

Strength of Cast-Iron to resist Crushing Strain (according to Hodgkinson).

No. of Experiments.	Name of Iron.	Height of Specimen.	Crushing Weight per Square Inch of Section. Pounds.	Tons.
1	Lowmoor Iron . . . . No. 1	1/2	64,534	28·809
"	" " "	1 1/2	56,445	25·198
2	" " . . . . . No. 2	1/2	99,525	44·330
"	" " "	1 1/2	92,332	41·219
3	Clyde Iron . . . . No. 1	1/2	92,869	41·249
"	" " "	1 1/2	88,741	39·616
4	" " . . . . No. 2	1/2	109,982	49·103
"	" " "	1 1/2	102,030	45·549
5	" " . . . . No. 3	1/2	107,197	47·855
"	" " "	1 1/2	104,881	46·821
6	Blaenwar Iron . . . . No. 1	1/2	91,860	40·562
"	" " "	1 1/2	80,561	39·564
7	" " No. 2	1/2	117,605	52·502
"	" " "	1 1/2	102,408	45·717
8	" " (2nd sample)	1/2	68,559	30·606
"	" " "	1 1/2	68,532	30·594
9	Caldn Iron . . . . . No. 1	1/2	72,193	32·229
"	" " "	1 1/2	75,983	33·921
10	Coltness Iron. . . . . No. 3	1/2	100,180	44·723
"	" " "	1 1/2	101,831	45·460
11	Brymbo Iron. . . . . No. 1	1/2	74,815	33·399
"	" " "	1 1/2	75,678	33·784
12	" " . . . . . No. 3	1/2	76,133	33·988
"	" " "	1 1/2	76,958	34·356
13	Badling Iron. . . . . No. 2	1/2	76,132	33·987
"	" " "	1 1/2	73,984	33·028
14	Ystalyfera Anthracite Iron No. 2.	1/2	99,926	44·610
"	" " " " "	1 1/2	95,559	42·600
15	Yniscedwyn " " No. 1	1/2	83,509	37·281
"	" " " "	1 1/2	78,659	35·115
16	" " " No. 2	1/2	77,124	34·430
"	" " " "	1 1/2	75,369	33·646
17	Morris Stirling's Iron, 2nd quality	1/2	125,333	55·952
"	" " " "	1 1/2	119,457	53·329
18 *	" " " 3rd do.	1/2	158,653	70·824
"	" " " "	1 1/2	129,876	57·980

(22.) **Memoranda on Timber; Causes of Decay.**—Decay in timber is caused chiefly by the presence of the natural juices or "sap," or from moisture which it may receive from various sources. The tendency to decay is greatly modified by—first, the natural properties of the timber itself; and, second, by the kind or quality of the sap. Timbers vary greatly in their natural properties, according to the physical, or we should perhaps say, the mechanical construction of the fibre, and partly to the nature of the sap. The construction of the fibre includes not only its form, but its substance also. This point is important, inasmuch as the evaporation of the watery portion of the sap of the wood, which is vitally necessary, is either facilitated or retarded, according as the fibre is open and spongy, or close and compact. And again, in woods where the fibre is close and compact, such as oak, beech, &c., the proportion of sap to fibre is much less than in the open and spongy woods, such as fir, willow, &c.

But although the porosity of wood is important, as being the medium of evaporation, the nature of the sap is a point of greater importance, for the following reasons. When a tree is cut down, it is charged with that quantity of natural moisture which has been necessary for its vegetable existence. Now, the second cause of the difference in the properties of wood, is the nature of the sap which has nourished it whilst growing. It is scarcely necessary to state that the sap of all trees is unlike; this difference is caused by the various proportions of different chemical substances which enter into its composition. For instance, the sap of some trees is more or less resinous, as that of the pine; gallic or astringent, as that of the oak; or mucilaginous, as that of the cherry tree, and according to the increased proportion of these substances which the sap contains, there is less liability to rapid decay; whilst, on the contrary, the more water the sap contains in its natural state, the less durable is the wood when deprived of vegetable life.

The decay of wood of all kinds dates from the time that its vegetable life has been destroyed by cutting down. From that moment the work of decomposition begins, and is expedited or retarded according to the nature of the wood, and the length of time that may elapse before the watery portion of its sap is evaporated. If, then, such moisture is allowed to remain, decay soon becomes perceptible; but, on the contrary, if it be expelled, the process of decay is so slow and so gradual in its operation, as to be imperceptible for centuries in some descriptions of wood; and hence the necessity for using well-seasoned wood.

The chief cause of decay in wood is generally understood to be the fermentation of the nitrogenous substances contained in the sap, caused by the oxygen in the air acting upon the moisture in the wood.

(23.) **To find the dimensions of Timber Beams.**—(*a.*) *To find the breadth of a pine girder where the bearing or distance between the walls, and the depth is given.*—Take the square of the bearing in feet, and divide it by the cube of the depth, and multiply the result by 74.

(*b.*) *To find the depth of a pine girder, the bearing and breadth or thickness being given.*—Divide by the breadth the square of the bearing, then multiply by 4·2 the cube root of the quotient.

(*c.*) *To find the breadth of a binding joist; the bearing in feet, or the length and depth in inches being given.*—Cube the depth, and divide by it the square of the bearing, and multiply the result by 40.

(*d.*) *To find the depth in inches of a binding joist, the bearing in feet and the breadth in inches being given.*—Divide by the breadth the square of the bearing, and multiply the cube root of the result by 3·42.

(*e.*) *To find the depth in inches of a tie-beam of pine, in which the bearing in feet and the breadth in inches are given.*—Take the cube root of the breadth, and divide the bearing by it, and multiply the result by 1·47.

(*f.*) *To find the depth of a beam supported at both ends, to sustain a given weight, the length and thickness or breadth of which is given.*—The weight, multiplied by the square of the length, and this by ·011, and the result divided by the thickness, gives a quotient, the cube root of which is the depth for pine.

(*g.*) *To find the thickness of a beam, the weight, length, and depth being given.*—The weight, multiplied by the square of the length, and the result multiplied by ·011, gives a quotient, which divided by the cube of the depth in inches, gives the breadth or thickness required. In both these rules, the weight to be supported must be in lbs.

(*h.*) *To find the dimensions of a pine post, to sustain a given weight.*

$$\frac{\text{Weight in pounds}}{\text{Divided by 1,000}} = \text{area in square inches.}$$

(*i.*) *To find the diameter of a round post of red pine to sustain a given weight.*—Weight in pounds, multiplied by 1·7, multiplied by ·0021. Multiply the square root of the result thus obtained by the height in feet, and the square root of the product is the diameter required. The length should not exceed ten times the diameter.

(*j.*) *To find the depth of a rectangular post of red pine, the breadth or thickness of which is given.*—Take the square of the length of the post in feet, multiply this by the weight in pounds which the post has to sustain; multiply the quotient by ·0021, and divide by the breadth in inches, the cube root of the quotient will be the depth of the beam.

(24.) **Memoranda useful in calculating the weight of Coverings for Roofs.**—(1.) The weight of a plain tile is 37 ounces, the dimensions $10\frac{1}{2}''$ long, $6\frac{1}{4}''$ broad, and $\frac{3}{8}''$ thick.

(2.) The weight of a pan-tile is 75 ounces, and its dimensions $13\frac{1}{2}'' \times 9\frac{1}{2}'' \times \frac{1}{2}''$ thick.

(3.) It takes 180 pan-tiles of 10″ gauge to make a square of roof covering: of plain tiles, 8″ gauge, 276; of ditto, 7″ gauge, 655; and of ditto, 6″ gauge, 768.

(4.) A "square" (100 feet) of plain tiling weighs 14 cwt. 2 qrs.; of pan-tiling, 7 cwt. 2 qrs.

(5.) A square of "Queens" slates will weigh $7\frac{1}{2}$ cwt.; of "Duchesses" 120 cwt.; of "Countesses" 134 cwt.; of "Ladies" 266 cwt.

(6.) A square of sheet lead, 7 lbs. to the foot, is 6 cwt. 1 qr.; 1 cwt. of 4 lb. lead will cover 28 superficial feet; of 5 lb. lead 22′ 5″; 6 lb. lead, 18′ 8″; of 7 lbs. lead 16′; of 8 lbs. lead 14′; 9 lb. lead 12′ 6″; 10 lbs. lead $11\frac{1}{4}'$.

(7.) A square of zinc; wire gauge No. 16, or $\frac{1}{16}$th of an inch in thickness, weighs 2 cwt. and 6 lbs.; of No. 22 wire-gauge, or $\frac{1}{32}$nd part of an inch, weighs 1 cwt. and 4 lbs.

(8.) A square foot of galvanized sheet-iron, No. 16 wire-gauge ($\frac{1}{16}''$), 40 ounces; of No. 22 ($\frac{1}{32}''$), 16 ounces. A "square" of timber boarding weighs $2\frac{1}{2}$ cwt. A square of the timber framing for roofs, covered with slate or tile, $5\frac{1}{2}$ cwt. Allow per "square" for force of wind pressure, 36 cwt.

(25.) **Spirals, Scrolls, and Volutes, and how to describe them.** (*See* note No. 8, p. 126.)—(*a.*) *To describe the scroll in fig.* 90.—Draw the lines *a b*, *b c*, at right angles, *a b* being the depth, *b c* the length of the scroll. Divide the height *a b* into eight equal parts, as in the drawing, and make *a d* equal to seven of these parts. From the point 4 in *a d* draw a line, 4 *f*, perpendicular to *a d*, and divide the distance between 4 and 5 on the line *a b* into two equal parts, and through it draw a line,

* This iron is composed of cast-iron with one fourth part of wrought iron melted into it.

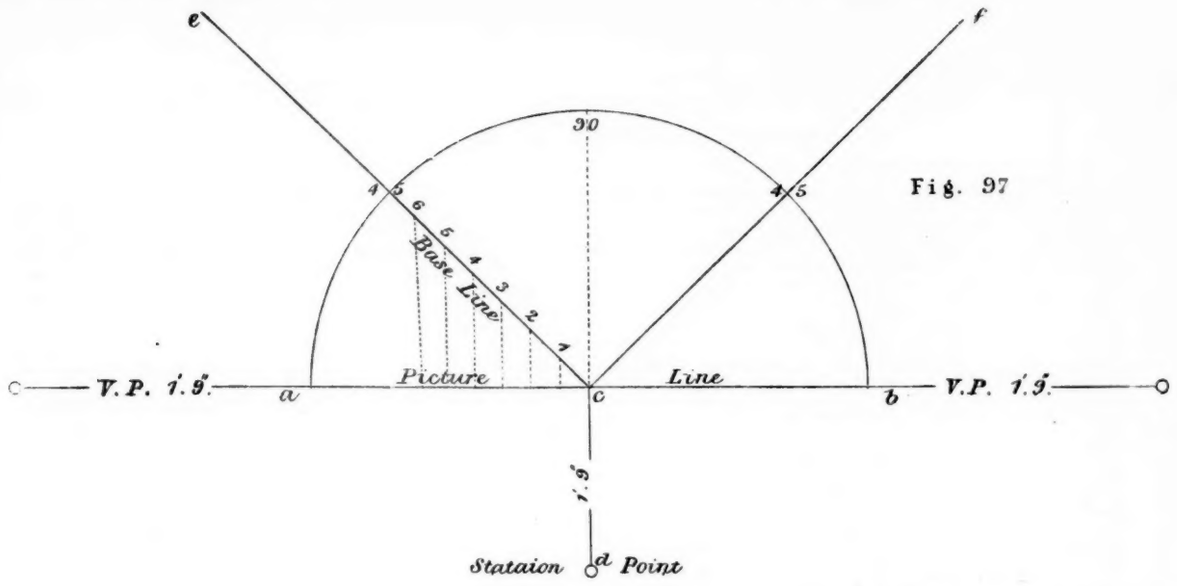


Fig. 97

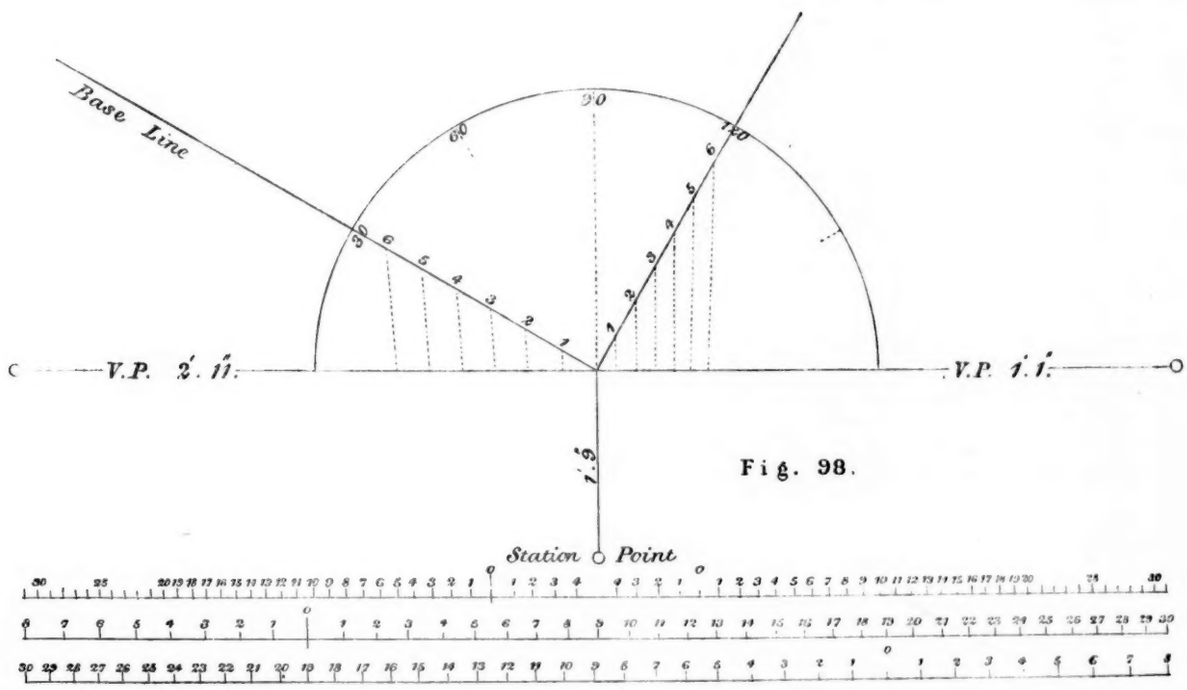
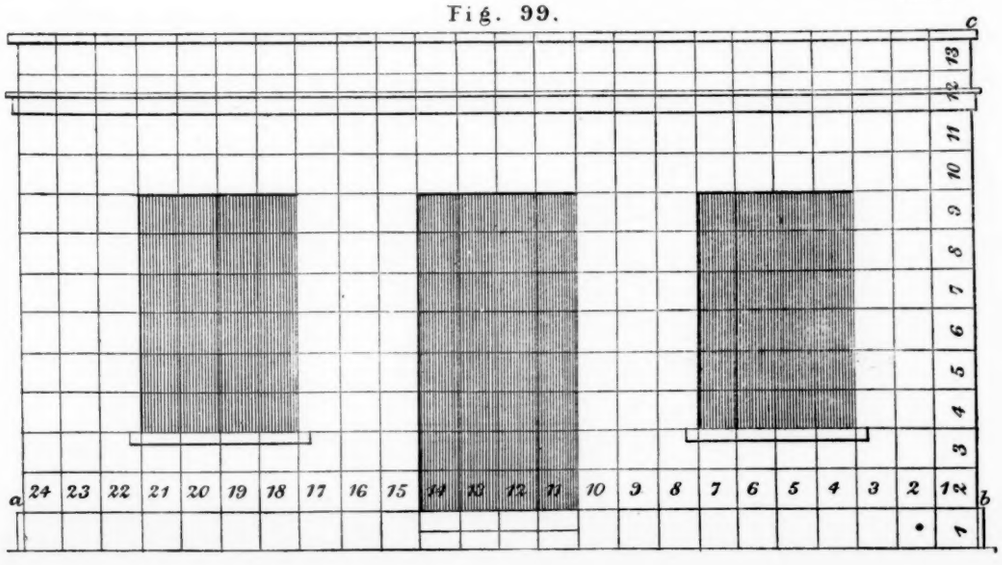


Fig. 98.

Fig. 99.



cutting the line *f* 6 in the centre of the eye, which is in diameter equal to one part on *a b*, as 4, 5. The eye is surrounded by a circle, *g h*, the space behind which, and the eye *f*, is usually ornamented with leaves after the Corinthian style; the part at A being also filled up with a scroll, and the part B and C connected by another scroll, terminating at D. The diameter of the circle *g h* is equal to 2⅔rd parts of the parts in *a b*, as the distance 4 *i* on the line *a b*. From the point *c* draw a line perpendicular to *a c*, as *c* 8, and divide this into seven equal parts, as on the line *g* 7. Make the depth of the scroll C equal to four of these parts, as from 3 to 7 on the line *g* 7, and divide *x* 8 into eight equal parts. From the point 8 on the line 8, 7, *b*, set off seven of the parts from the line *c* 8, and draw the line 7 C. From the fifth point on the line 8 7 *b*, draw parallel to *a b*, the line 5 *k*; the intersection of this, with a line dividing the space 4, 3, on the line *c* 8 into two equal parts, gives the centre of the eye *i*, which in diameter is equal to one of the parts on the line *c* 8. The eye *f* of the larger scroll is divided as in fig. 91, and on this the various centres are marked, from which the curves of the large scroll are described. The parts 4 4, from 4 on line *a d* to 4 on line *a b*, fig. 90, being described from the centre 1, fig. 91. The part from 4 to *l* from centre 2, the part from *l* to *m* from centre 3, from *m* to *n* from centre 4, from *n* to *o* from centre 5, from *o* to *p* from centre 6, from *p* to *q* from centre 7, from *q* to *r* from centre 8, 2 to 5 from centre 1. Set off from point 4 on line *a d*, fig. 90, to point *t*, and from centre 1, fig. 91, with distance 1 to *t*, describe the arc *t u*; from centre 2 the arc *u v*; from centre 3, the arc *v w*. The centres of the eye *i* of the small scroll in fig. 90, are shown in fig. 92. The positions being reversed—as the scroll runs the opposite way—from those in fig. 91. From the fourth centre in eye of scroll, fig. 90, draw parallel to *c b*, the line *y x*, fig. 90; and make the distance from top of scroll *y* to *x* (for want of space the point *x* is not shown in the drawing, but it is in the line *v y*, fig. 90, produced) equal to two parts on the line *a b*. From the point *x* as a centre, with radius *x t*, describe the curve *t z*: and from the same centre the curve 4 *a'*. With the same radii join the tops 5 and *b'* of the small scroll, and the arcs described from the point *x* of the large scroll, with arcs *z* 5, *a' b'*. The centre of these arcs will be found on a line drawn through the point 5 on the line 8 7 *b*, parallel to *a b*.

(*b.*) *To describe the curve for a spandrel step, as in fig.* 93.—1. Let *a b* be the height. Divide the length *a c* into six equal parts. Through the second of these draw a line 2 *d* perpendicular to *a c*. Divide the spaces between 2 and 3, and 3 and 4 into two equal parts, in the points *e* and *f*. From the point 2 as centre, with the distance 2 *e* as radius, describe the arc *e d*, cutting 2 *d* in the point *d*. From the point 5 as centre, with the distance 5 *f* as radius, describe an arc 5 *f*, and cut this in the point *g* with a line perpendicular to *a c* from the point 5. Then from the point 2 as centre, with distance 2 1 as radius, describe a quadrant 1 2; and from the point *d*, with *d h*, an arc *h i*, and from the point *g* as centre, join this to 5, with an arc 1 5. Another method is illustrated in fig. 94. Let *a b* be the length of the whole curve. Divide this into twenty-four equal parts, and make *a c* equal to 14 of them, *c b* being 10. Make *c d* equal to 5 of these parts, and through *d* drop perpendicular to *a b* a line *d e*. Make *a f* equal to 4½ parts, and divide *f d* into three equal parts, and set one of these parts off from *d* to *g*. From *g* as a centre, with distance *g h* as radius, describe an arc cutting line *d e* in the point *e*. From *h* as a centre, with distance *h f* as a radius, describe an arc *f i*, and from point *e* as centre join *i c* with another arc. Make *b k* equal to nine of the 14 parts into which *a b* is divided, or make *b k* equal to *c b*. Join *c k*, and divide the line into seven equal parts. From the first and 6th points as centres, with distance 16 as radius, describe arcs cutting in the point *m*. From *m* as a centre, with *m c* or *m k* as radius, describe the arc *c k*. In copying the drawing in fig. 90, the pupil should make his drawing to a much larger scale, so that the centres of the curves of the scroll will be easily seen, and the relation of the parts one to another traced with a facility not afforded by the small drawings our space compels us to adopt.

(26.) **Temperature of Steam at Various Pressures above that of the Atmosphere (Fah.).**

Pressure.	Temp.	Pressure.	Temp.
5	227°	10	239°
15	248	16	252
17	253	18	255
19	257	20	259
21	260	22	262
23	264	24	265
25	267	26	268
27	270	28	271
29	272	30	274
32	277	34	279
36	282	38	284
40	286	42	289
44	291	46	294
48	296	50	298
52	300	54	302
56	304	58	305
60	307	62	309
64	311	66	313
68	314	70	316
72	318	74	319
76	321	78	322
80	324	82	325
84	327	86	328
88	330	90	331
92	333	94	334
96	335	98	336
100	338	105	341
110	344	120	350
125	353	130	355
135	358	140	361
145	363	150	366

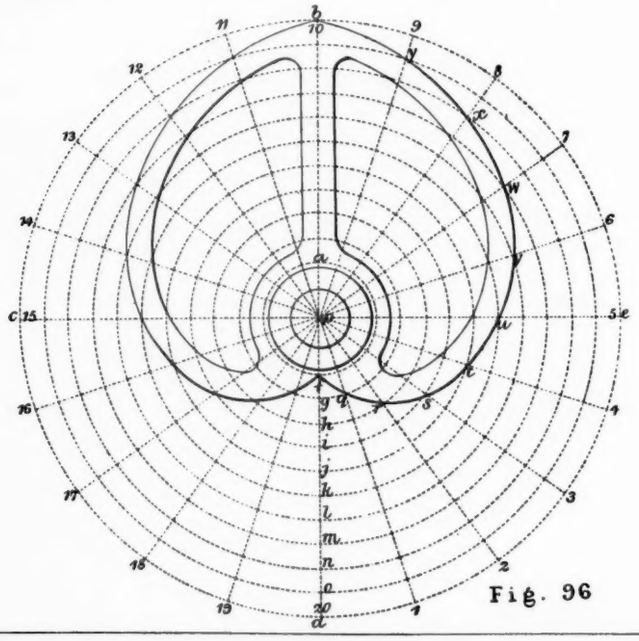


Fig. 96

(27.) **Eccentric Curves and their Application to the Delineation of Mechanical Movements, as "Cams, &c."**—The problems connected with the describing of eccentric curves, are not only in themselves interesting as affording excellent practice for the young draughtsman and student in mechanical drawing; but are very useful in projecting the lines of those parts of mechanism known as "cams," "heart wheels," and the like, in which variable motion is required. (*a.*) Fig. 95 will illustrate the principle upon which eccentric curves are constructed. In a succeeding note we shall give problems connected with the curves known as the "cycloid," the "epicycloid," "cissoid," "conchoid," and the "involute." In fig. 95, let *a b c d* be the dimensions of the curve or the circle which limits the path of the "cam" or revolving part. The peculiarity of a revolving cam is, that if connected with a part having rectilineal motion, it will give that part an alternate to and fro, or backward and forward motion, of a varying character as to speed. Let the "throw" or vertical rise and fall given by the "cam" be equal to the distance *c e*. Divide this into two equal parts in the point 11, and from 11 as centre, with 11 *e* or 11 *c* as radius, describe the circle *c* 4 *e*. Divide half of this as *c* 4 *e* into any number of equal parts, as eight in the diagram. And from points thus obtained, as 1, 2, 3, &c. draw lines perpendicular to the diameter *c a* of the large circle *a b c d*. A series of points will thus be obtained on the line *c e*, as 9, 10, 11, &c. Next from the centre *f* of the large circle *a b c d*, with radii, as *f* 9, *f* 10, *f* 11, *f* 12, *f* 13, *f* 14, describe a series of concentric circles as shown in the diagram. Next divide the circumference of the large circle *a b c d* into double the number of parts into which the semi-circle *c* 4 *e* is divided. This will give 16 points in *a b c d*. Through these points draw radial lines to the centre *f*. The intersection of these radial lines with the circles described from *f*, with radii as *f* 9, *f* 10, &c. will give a series of points through which a curved line may be drawn by hand. This curve will be the periphery or outside line of the cam, as required. Thus the intersection of the first circle *f* 8 with the first radial line *f g*, gives the first point 7; the intersection of the second circle *f* 9 with the second radial line *f h*, gives the second point *s*. The intersection of the third circle *f* 10 with the third radial line *f i*, gives the point *t*; fourth circle *f* 11 with fourth line *f b*, gives point *u*. The point in the fifth circle *f* 12 with fifth radial line *f j*, the point *v*. The sixth circle *f* 13 with fifth radial line *f k*, the point *w*. The sixth circle *f* 14 with sixth radial line *f l*, the sixth point *x*. The last point being in the termination of the line *f a*. The curve drawn from the point *e* to *a* through the points 7 *s t u v w x* gives half the outline of the eccentric curve required. The other half is put in by finding points which correspond to those already found, these being at *y*, *z*, *a'*, *b'*, *c'*, *d'* and *e*. The student will perceive that the points, as *v* and *x*, are connected not by straight but curved lines. These are drawn with an accuracy proportioned to the number of points, as *v x*, &c. which are found. The greater the number of points the better, and therefore the greater the number of parts into which the circumference of the circle *a b c d*, and the diameter *c e* of the smaller circle, the more numerous will the points be. To prevent confusion and to show the relation of the lines to one another, we have divided the circles in the diagram into as few parts as possible consistent with its accuracy. (See remarks at end of Note 25.)

(*b.*) In fig. 96 we illustrate the method of finding eccentric lines to give the outline of a heart-shaped "cam." In this *a b* or *d f* is the throw of the cam; and the circle *b c d e*, the size of the curve. Draw the circle or eye of the cam *a f*. Divide the circle of *b c d e* into any number of equal parts—the greater the number, the more the number of points through which the curve is to be drawn (see remarks on this point in the last paragraph), and through these points draw radial lines to the centre, *p*. Divide *f d* into a number of equal parts, amounting in number to half of those into which the circle *b c d e* is divided. Then from centre *p*, with radii as *p g*, *p h*, *p i*, &c. describe circles concentric to *b c d e*, the intersection of these with the radial lines as 1 *p*, 2 *p*, 3 *p*, &c. will give points through which the curve will be drawn. Thus the intersection of the first circle, *p g*, with the first radial line, *p* 1, will give the first point *g*; of the second circle, *p h*, with the second radial line, *p* 2 will give second point *r*, the point *s* is found at the intersection of *p i* with *p* 3, at *t* the intersection of *p j* with *p* 4, or at cutting of *p k* with *p* 5, the points *v* at cutting of *p l* with *p* 6, point *w* at cutting of *p m* with *p* 7, point *x* at cutting of *p n* with *p* 8, point *y* at cutting of *p o* with *p* 9. In these diagrams we have shown, by dark full lines, two of the many ways in which the cams may be finished; with void parts, so that the weight may be reduced, and a greater elegance of form obtained than would be given if the cam were merely a solid block.

(28.) **A Method of Delineating Architectural and Mechanical Subjects in Perspective, to which the usual Scales of equal parts are applicable in reading off Dimensions.**—In Note No. 2, p. 27, on isometrical drawing, we stated the objections to ordinary perspective in respect of the difficulty or rather the practical impossibility of taking measurements from drawings done in this style, and which would be capable of being taken from, or applied to scales of equal parts used in general practice. This it will be perceived is an objection which concerns those who are engaged in carrying practically out the designs of architects; but there is another objection to ordinary perspective drawings which concerns the architects who design the *plans*, and who are desirous to show their clients the general effect of these plans, as they would present when built. For it is to be remembered that the majority of the *clients* of architects do not, as a rule, easily understand working plans, elevations, and sections—*orthographically drawn*—at least, have a difficulty to comprehend what will be the general appearance of the house, &c., when built from such plans. Architects, therefore, find it frequently a desirable thing to show their clients drawings of the building in perspective. And here comes in the objection to perspective drawings we have above alluded to; namely, that such drawings take considerable time to do, and are when done of no further use than as show drawings, being unfitted by the special system upon which they are constructed to give measurements, or to allow of measurements being applied to them. The system of isometrical delineation, which we in two Notes have attempted to explain, affords obviously an easy way in which the general effect of a proposed building may be shown; to one not able intelligently to understand what the effect would be, from such information as orthographic or geometrical plans and elevations afford. But some architects object to isometrical delineations as being too bald, and what we may call "square" in their effects, hence they prefer to go to the much greater trouble which is involved in the preparation of ordinary perspective drawings. The Architect, to whom we are indebted for the succeeding illustrations of a system somewhat novel, not only from the principle upon which it is based, but from the great facility with which drawings can be constructed upon it, in the course of an extensive practice, found that the objections to ordinary perspective already stated presented great obstructions to his preparing "show drawings" for his clients; and struck with the simplicity of the method of isometrical delineations, he gave some consideration to the devising of a method of perspective delineation which would possess all the advantages, but none of what he considered the disadvantages of the method of isometrical delineation. The result of this consideration was the "hitting" upon the method which in the present, with a few, and further illustrations to be given in a succeeding Note, we purpose to explain.

It is claimed for this method that it possesses the advantage of being easily understood and easily applied, and the additional great advantage, that from the perspective elevations prepared by it measurements from any scale of equal parts may be taken which can be at once applied to the preparation of the ordinary geometrical or working elevation; the method involving the use of what may be called a "perspective scale," this bears an exact relation to the ordinary scale decided upon; so that measurements can be taken from the perspective drawing and applied to an ordinary drawing.

The method has been found by its author of great use in preparing perspective elevations from rough pencil sketches with known dimensions, without in the first instance preparing finished or accurately projected plans. The architect or builder, in full practice, will at once see the practical advantage arising from this in the saving of much time and labour. In perspective drawings prepared by this method, all vertical lines are measured from the "perspective scale," and all horizontal lines from the ordinary scale of equal parts decided upon. The horizontal lines so measured from the ordinary scale are not drawn parallel to one another as in ordinary geometrical drawings, but are drawn to vanishing points. A comparatively brief study of the succeeding illustrations will enable the student to understand the peculiarity of the method, and to draw perspective elevations founded upon it with as much facility as ordinary geometrical drawings. We need scarcely remind the student that he will arrive at an intelligent understanding of the method much more quickly by taking the drawing-board, and drawing out on a larger scale all illustrations we propose to give. This remark or advice applies, we may say *en passant*, to all the subjects of our Notes in which drawing a projection is concerned. In practising the method, the author of it has been accustomed to use the perspective and ordinary scale to find the main lines and angles only of the drawing, filling in a good number of the parts by the hand, guided by the eye only; as is done in the work of ordinary perspective drawing; thus saving a good deal of time, especially in the case of preliminary sketches.

The method of finding the perspective scale, will be seen in

figs. 97 and 98, which illustrations are also designed to show the general principle of the system and the mode of its application. The line *a b*, fig. 97, is called the "picture line." The lines *c e*, *c f*, may be considered part of the lines of two walls of a house meeting at the corner, *c*. The angle at which these lines are set is that found by the author to be most useful in practice. The illustrations show how the diminishing or perspective scale can be obtained of greater length than shown, if this greater length be required. To obtain the "perspective scale" to the diagram in fig. 97, draw along the edge of the "T-square" the horizontal line" *a b*, which forms the "picture line" of the perspective drawing. On this line assume any convenient point *c*; and draw with the "set square" (right-angled triangled), the lines *c e*, *c f*, representing part of the lines of walls, meeting at *c*, these being called the "base lines" of the perspective drawing. These lines form in the illustration an angle of 45° with the "picture line" *a b*. Take from an ordinary scale the distance of a quarter of an inch, and set it along the line of wall *c e*, from the point *c*, to a series of points numbering them as shown, 1, 2, 3, 4, &c. From the point *c*, at right angles to the "picture line" *a b*, draw a line to the point *d*. This point is called the "station point," or "point of sight," and its distance from *c* to *d* is to be 1 foot 9 inches. Next, from the points marked 1, 2, 3, 4, &c., on the "base line," draw a series of light lines all converging to the

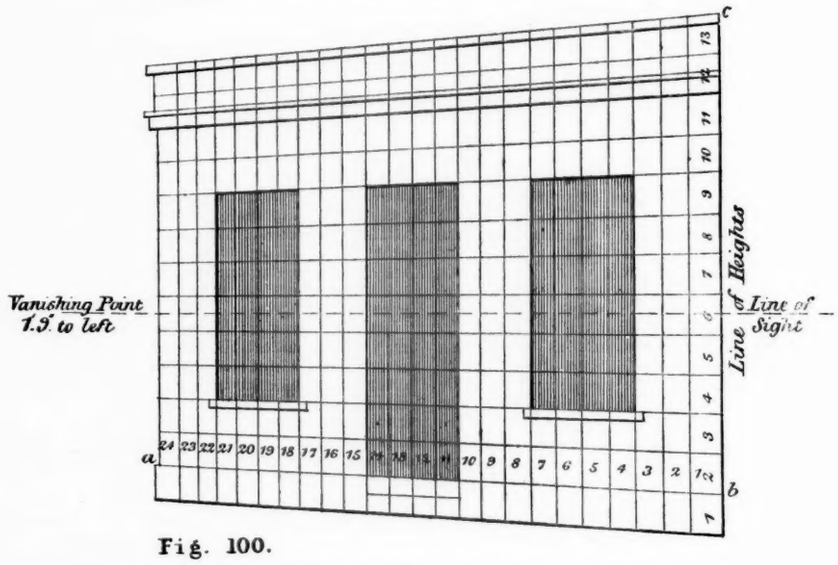


Fig. 100.

"station" or "vanishing" point *d*; these will cut the "picture line" *a b*, in certain points, and these will give the distances which will be the "perspective scale." If these points are transferred to a horizontal line, drawn [at a convenient part of the

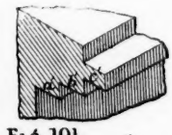


Fig. 101.

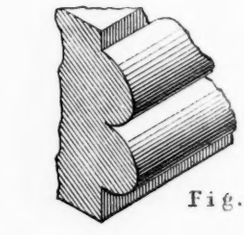


Fig. 102.

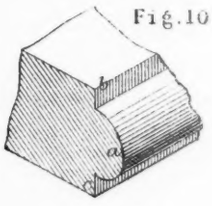


Fig. 103.

paper, and numbered, they will form the scale as in the lower part of the diagram in fig. 97, the ordinary scale being also there given. Those parts of the scale from 0 up to 10 to the right hand of the upper scale, and those to the left on the lower scale in fig. 97, indicate or give what may be called supplementary scales, the measurements of which will be found occasionally useful in setting out parts, which project slightly beyond the base lines, *c e*, *c f*, such as string courses, cornices, and the like.

The scale in fig. 98 is found in precisely the same way as that given in fig. 97; the vanishing points to right and left of the diagram being, however, of different lengths, as shown.

The use of the scale, and of the vanishing points, will be found illustrated in figs. 99 and 100; fig. 99 representing the elevation of a house drawn to a scale of "$\frac{1}{4}$ inch to the foot." This is divided into a number of squares, each representing, according to the scale, a superficial foot, and is here given to show the application of the "perspective scale." This being known or given, the perspective drawing in fig. 100 could have been drawn with just as much facility as the geometrical drawing in fig. 99. The method of so drawing, fig. 100, may briefly be described as follows: Draw the line *a b*, to represent the bottom or plinth line of the house, and which is called the "line of length," and set off on it, from perspective scale—previously found by the methods shown in figs. 97 and 98—distances to represent the length of 24 feet, the same as shown in the elevation, which, as before mentioned, is drawn to an ordinary scale of "$\frac{1}{8}$ inch to the foot." On the perpendicular line *b c*, which is called the "line of height," set off a number of distances taken from the perspective scale, to represent 13$\frac{1}{2}$ feet. The vanishing point placed on the "line of sight"—so marked in the drawing—is situated 1 foot 9 inches to the left of *b c*, the "line of height." Draw from this vanishing point lines from all the points of division marked on *b c*, the line of height. Next draw lines from the divisions on the "line of lengths," *a b*. This will give the area of frontage of the house marked off with a series of squares, all in perspective. The openings of doors and windows, or rather the position which they occupy, can be at once ascertained by taking the measurements (decided upon) from the scale, and marking them off. Or, as each square is a foot, if the distance of outside line of window opening is known, it can at once be found by counting the squares, and dividing them, if necessary, into the fractional parts required, half the distance of any one division or square being, of course, six inches, one-fourth of it three inches, and so on. Any ornamentation required can be put in at the various parts by hand, and with sufficient accuracy to give an idea of the general effect, even by a draughtsman not very proficient in his art. In our next Note we shall give further illustrations of this system.

(29.) **The Architectural Mouldings, and How to describe them.** — The various parts of an architectural design such as string-courses, cornices, the ornamental features given round doors and window openings, &c. are made up, it will

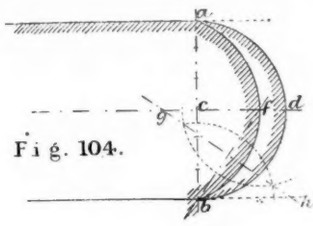


Fig. 104.

be observed, of an assemblage of members, the sections of which are either rectangular, or formed of curves varying in position and in relation one to another. These members are called "mouldings," and serve to connect or bind the various parts together. In classical architecture the direction in which mouldings lie is generally horizontal. Those which are curved in section are in what is called the "Roman style," formed of arcs or parts of circles, described from centres. In what is called the "Grecian style;" the curves are parts of ellipses, hyperbolas, or parabolas. The outline given by the Roman mouldings is therefore not so graceful or pleasing to the eye as those afforded by the Grecian mouldings. The mouldings formed in the Gothic style are much more diverse in character of outline than those of the "classical" style, so-called, which embraces both Roman and Grecian. These classical mouldings we name here as follows :— The "fillet," the "bead," the "torus," the "ovolo," "cyma-recta," "cyma-reversa," "cavetto," "seotia." These have other names which we shall give as we proceed in illustrating and describing them. The "fillet" illustrated in fig. 101 at *a a a* is rectangular in section. If the depth or thickness is small it is termed a "fascia," and if it is not connected with any other member it is termed a "band." The term "corona" is applied to a projecting member of a cornice of which the section also is rectangular. The fillet is also sometimes called a "listel," "annulet," "square," and "cincture." The fillet usually divides other mouldings from one another, or terminates an assemblage of mouldings. The "bead," as infig. 102, is semi-circular in section; if it is of small diameter it is so called, if of a large, a "torus;" when small and

Fig. 106.

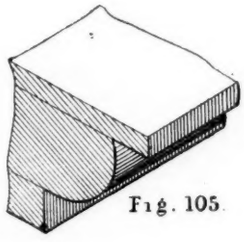


Fig. 105.

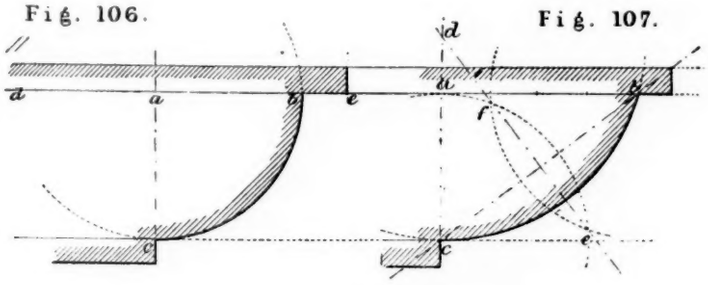
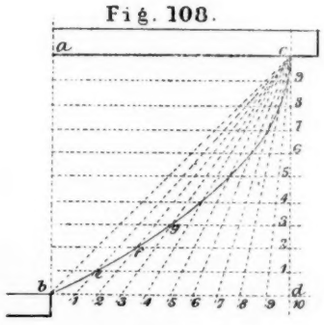


Fig. 107.

Fig. 108.



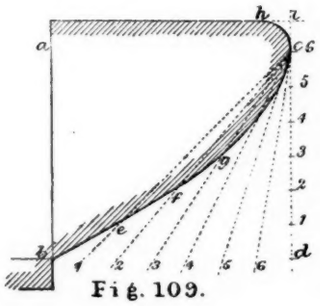


Fig. 109.

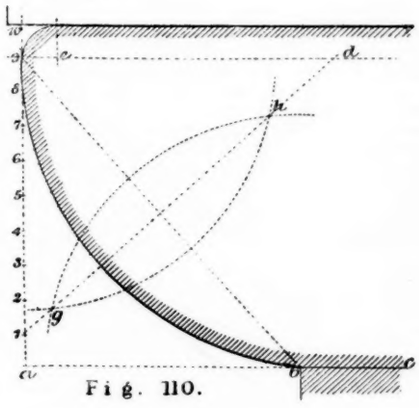


Fig. 110.

terminated above and below by fillets, as *b* and *c* in fig. 102, it is termed an "astragal." Fig. 103 is a double bead. When there are more than two the assemblage is called "reeds." The torus or bead is simply described by dividing the height *a b*, fig. 104, of the moulding into two equal parts in the point *c*, and from this as a centre, with *c a*, *a c b* as radius, describing the semi-circle *a d b*. In some designs the projection is less than in fig. 104, and then the moulding is sometimes designated the "swelling frieze." The inner line *a f b*, in fig. 104, illustrates this; the proportion of projection *e f* to height *a b* is two-sixths; the height *a b* being divided into six equal parts, two being set off from *c* to *f*. Join *b f*, and bisect it by a line *g h*. Through *c* draw at right angles to *a b* a line *d c g*, and produce the line *h g* till it cuts the line *d c* in point *g*. From *g* as a centre, with *g b* as radius, describe the arc *b f a*. In fig. 105 we illustrate the "ovolo," "quarter round," or "echinus." In the Roman style this is simply a quadrant or a quarter of a circle, the radius of which *a b*, fig. 106, is equal to *a c*, the depth or height of the moulding; the centre *a* being on the upper or bounding line *d e* of the moulding. In some cases the "ovolo" is formed of an arc of a circle less than a quadrant, as in fig. 107; the projection *a b* being greater than the height *a c*. The proportion in the example being four to three. To describe the arc forming the contour of the moulding, let *c* be the terminating point of the moulding, at its lower side. Draw a perpendicular line, *c a*, produced to *b a*. Join *c b*, the terminating point *b* of the moulding, and from *c* and *b* with any radius greater than half *a b*, describe arcs cutting in *e* and *f*; through these draw a line cutting the line *c a* in point *d*. From *d* with radius *d c*, describe the arc *c b*. As already stated the mouldings of the Grecian style are not described by arcs of circles, but are bounded by lines forming parts of ellipses, parabolas, and hyperbolas, these being drawn through a series of points. In fig. 108, we illustrate the Grecian "ovolo," corresponding to the ovolo in fig. 106, in which the height *a b*, is equal to the projection *a c*; the curve *c b* being part of an ellipse. To find this curve from terminating point *c*, draw a perpendicular line, *c d*, and from *b* a line *b d*, perpendicular to *c d*. Divide *b d* into any convenient number of equal parts, as ten in the diagram, and also *c d* into the same number of equal parts. Through the points in *c d* draw a series of lines parallel to *b d*; and from the points on *b d*, another series converging to the point *c*. Number the points 1, 2, 3, 4, &c., on both lines *b d*, *c d*, the lowest number on the one line being nearest the highest number on the other line, the intersections of the corresponding lines will give a series of points through which the curve is drawn by hand. Thus the intersection of the line 1 *c* from

point 1 on *b d*, with the line drawn from point 1 on *c d*, gives the point *e* of the curve. The point *f* is found by the intersection of the line on *b d* drawn from 2, with the line drawn from point 2 on *c d*, and so on. In fig. 109, the projection *a c*, is greater than the height *a b*, but the curve is found in the same way. In place of terminating as at *c* in fig. 108, the Grecian ovolo is usually finished as at *c h*, this part being termed technically a "quirk;" in fig. 109 this quirk is equal in height to from *c* to *i*, and in projections from *i* to *h*, to one of the parts on *c d* or *b d*, the curve *c h* being put in by hand, and so as to continue the curve *b e f g c*. Properly the curve of the quirked part should be formed by the same operation, which gives the other part of the outline of the moulding. Fig. 110 shows a quirked ovolo described by arcs of circles, as fig. 106. Let 10 *a* be the height of the moulding, which divide into any number of equal parts, as ten, in the diagram. From *a* perpendicular to *a* 10, draw a line *a b c*, and make *b a* equal to eight of the parts in *a* 10. Through the ninth point draw parallel to *a b c*, a

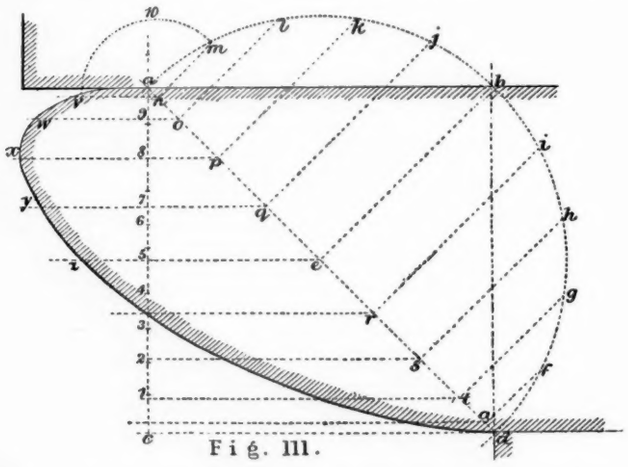


Fig. 111.

line 9 *d*, and from 9 set off one of the parts on line *a* 10 to the point *e*, and from *e* with same radius describe the quadrant 9 *f*. Join 9 *b*, and bisect 9 *b* with a line 9 *h* cutting 9 *d* in *d*. From *d* with *d* 9 or *d b* describe the arc 9 *b*. The curve of a Grecian *quirked* ovolo, is found in a number of ways, one of which is illustrated in fig. 111, the curve being part of an ellipse. Let the square *a b c d* be drawn, the side *a c* of which gives the depth or height; *b a* the projection to inner termination of the "quirk" of the moulding. Draw the diagonal *a d*, and divide this into two equal parts in the point *e*, and from *e* as a centre, with *e d* describe the semi-circle *d b a*. Divide *a c* into any number of equal parts, as ten, and also the semi-circle into the same number in the points *f g h i*, &c. Perpendicular to *a d* from the points *f g h*, draw lines to the line *a d*, as *m n*, *l o*, *k p*, *j q*, &c. and from these points in *a d*, draw, parallel to *c d*, lines as *n v*, *o w*, *p x*. Then measure from *n* to *m*, and set this distance off to point *v* on line *n v*, which may be done by describing the arc *m* 10 *v*. With distance *o l*, set off from point *o* to *w*; with *p k* to *x*, and so on, and through the points thus found draw the curve by hand as *a v w x y z* 3 *d*.

FRENCH PORCELAIN.

VINCENNES.

THE historian of the arts, who fairly collects and brings into relief the elements of their history, is likely to incur the charge of hyperbole, even whilst he understates the truth. To say, for example, that the Europe of the sixteenth century was profoundly excited by the appearance of Oriental pottery; and that men of science and working men combined their efforts to discover the secret of the manufacture of this pottery, may seem exaggerated, but it is, nevertheless, no more than the truth.

At present we shall confine ourselves to a consideration of the labours of French artists, and we may only say in justification of the enthusiasm with which Oriental pottery was received, that, though it was appreciated at first rather as an object of curiosity, it astonished every one by its delicacy, brilliancy, and translucence. There was an immense difference between this homogeneous, thin, sonorous, glossy pottery, and the porous earth which was supposed to resemble tin-enamel, the least defect of which was extreme fragility, with an appearance of excessive strength. At a later period the rich were induced to furnish their tables with services imported from China and Japan; they even sent paintings of their armorial bearings to the East, to be copied by the *hoa-pei*, to the minutest particular, and multiplied on pieces of porcelain without number. This mild form of insanity caused a serious drain of specie from France to the East, which exercised the statesmen as well as the commercial classes of the day.

Inventors were encouraged by men in power to prosecute the search for the means of imitating or reproducing Chinese porcelain. In 1664, Claude Réverend, a citizen of Paris, received a patent to manufacture *delph ware*, and *to imitate porcelain as good as, and better than, what came from the Indies.* In 1673, another, Louis Poterat, of Saint-Etienne, obtained the privilege for thirty years, to manufacture *porcelain similar to that of China, and delph like that of Holland.* But it was reserved for the Chicanneau family to successfully imitate and surpass the porcelain of China itself. Pierre Chicanneau and his children had been working at the problem in the year 1696, and for some years previously. In that year they succeeded in making "true porcelain of the same quality, finer, and as perfect and suitable for use as the porcelain of China and India;" and by a decree of 1702, the family were permitted to conduct the manufactory of Saint-Cloud, which had become a genuine commercial enterprise.

Before proceeding further, it may be well to examine the ordinary French porcelains at that time. In the seventeenth century, chemistry was hardly known, and geology did not exist. All that was vouchsafed by science were a few vague particulars. They had, therefore, to proceed on the system of trial and failure. Glassworkers tried to devitrify their productions, in order to make a sham porcelain. The enamellers completed in the oven pieces whitened by oxide of tin. But all this was not even an image of the pottery in request.

The ceramists were more fortunate. By dint of manipulating the marls and alkaline matters, they discovered a frit, or mixture—a mass that was capable of being entirely fused at a high temperature, and of becoming translucent by a partial fusion. On mixing this mass with chalk and calcareous marl, they formed a paste, refractory, it is true, and difficult to work, but which, when covered with a varnish of silica and lead, formed an imitation of Chinese porcelain, and surpassed it for the reception and perfection of painting. Thus, without kaolin (the Chinese clay), or felspar—the essential elements of Chinese pottery– a charming ceramic was produced which has not been superseded even by the ultimate discovery of the minerals proper to form the "hard paste."

The privilege accorded in 1702 to the heirs of Chicanneau, was the signal for redoubled efforts; on all sides, people set to work. In 1713 the brothers Dorez opened a manufactory at Lille, for the production of imitations of the pottery of Saint-Cloud. Towards 1725, the Duke of Orleans, who possessed an

experimental laboratory at Bagnolet, had occupied himself with attempts to discover the secret of porcelain, and was desirous of co-operating, by his counsel, with the Chicanneaus. Other grandees followed his example; the Prince of Condé built a manufactory at Chantilly, under the direction of Ciquaire Ciroux, for the imitation of the finest porcelain of Japan,—what has been called archaic pottery. The prince liked this pottery, of which he possessed a remarkable collection, and the happy efforts of Ciroux may be appreciated by the examples of his manufacture in the possession of MM. Paul Gasnault, Conte de Beaussia, and others. His works are known by the stamp of a French horn—his trade-mark.

Ten years later, in 1735, a new factory was erected by the Duke of Villeroy, at Mennecy, in charge of François Barbin. His paste is milky and very transparent, and is varnished with lead.

In 1740, our neighbours had been progressing, like us. Since 1708, Böettcher had discovered, in Saxony, the secret of the true porcelain. In England, a fine *naturello* porcelain was made. The administration in France took the alarm, being desirous to direct and to protect French industry. Two workmen of the name of Dubois, from the factory of Saint-Cloud, proposed to M. Orry de Fulvy, brother of the minister of finance, to divulge to him the secret of porcelain, and to work it practically on certain pecuniary conditions. These proposals were well received, and the men were installed in a laboratory at the Castle of Vincennes. In the course of three years they expended two and a-half millions sterling in fruitless efforts, and they were finally expelled for misconduct. Amongst the workmen employed by them there was a man of intelligence and activity, of the name of Gravaut, who had perceived in the course of the experiments the germs of an important discovery. He continued the researches, and soon obtained a soft, artificial porcelain, of which he communicated the composition to M. Orry de Fulvy. Thereupon, a company was formed in 1745, to carry out the discovery. The imitation porcelain immediately became popular. Everywhere the obedient paste was rolled into petals under the fingers of ladies; the colours, borrowed from the metallic oxides, sunk into the material in soft tints, and rendered, like life, the double anemonies, jagged poppies, roses, tuberoses, and the narcissus.

About the middle of the century, the truly French style of decoration was manifested in first-rate works of porcelain, such as the oval plateau with rock-work undercut in relief, in the collection of M. Double, with birds in the foreground, and groups of shell-work and fishes on the circumference. The rich proprietor of this work caused it to be framed in gold chased with delicate foliage and graceful arabesques.

The taste for delicate colours gave birth to two tints singularly well appreciated—the rose colour, improperly called *rose Dubarry*, and the turquoise blue. The first is seen on several precious vases in the collection of M. Double, manufactured in commemoration of the battle of Fontenoy. On a fine rose colour, marbled with blue and gold, hang on the outside the medallions suspended by chains, on which are figured two episodes of the battle, with emblems of victory. Cords hang down and are attached to the sides of the medallions, contrasting by their whiteness with the rich painting on the waist of the vase. The effect is graceful and elegant; and the vase should be of the period of 1746 or so, for it would not have been many years after the campaign of Louis XV. that the composition of such a monument would have been thought of.

The example of France was followed in other countries. In 1754, the Empress of Russia wanted to possess specimens of that marvellous porcelain which had become famous throughout Europe. She ordered a complete service, to be decorated with delicate paintings and imitations of antique cameos. She had not counted the cost when she gave the order; it amounted to the sum of 360,000 livres, or about £18,000. She was astonished. Diplomacy interfered and explained; ultimately the bill was paid. All this agitation but added to the renown of the manufactory at Vincennes, which became too small for the increasing business. The company purchased, halfway towards the capital, on the Sèvres road, the house and grounds of Lully, the musician, and in 1756 built a factory which was on a scale deemed sufficiently large to accommodate the business for all time coming. At the present day, these works, in a ruinous condition, have become, in their turn, insufficiently commodious.

SEVRES.

Sèvres, or *Seve*, as the name was written, became the general appellation for French porcelains.

The directors of the royal factory at Sèvres demanded not only protection, but a monopoly. They contrived to secure it, too, by a decree of the 17th February, 1760, which hardly permitted the other factories to continue to manufacture white pieces, or pieces decorated in blue cameo. In 1763, all persons, of whatever rank or station, were forbidden to make, or cause to be made, to model, paint, or gild, any works in porcelain, or to sell them, under a penalty of confiscation of the works, the destruction of the furnaces, and a fine of 3,000 livres. The severity of the measure led to its own failure. The porcelain makers, the dealers in earthenware, ruined at a blow, loudly complained, and it was necessary to meet their just demands; and the decree of February, 1766, to meet this object, explained that, whilst it was important to maintain the royal porcelain factories in the enjoyment of their privileges, it was still more important to encourage a branch of commerce favourable to national industry, when the raw material was abundant everywhere. It was, therefore, permitted to manufacturers throughout the kingdom to manufacture porcelain in imitation of Chinese, with such materials as they chose, either in white or in blue and white, and in cameo of one colour, provided that each manufacturer adopted a special or trade mark, and deposited it with an undertaking to use it constantly, before competent authorities.

Re-assured by this protective decree, the works already existing recommenced their manufactures, but they sought to elude the troublesome prohibitions. Other works were started, and painted flowers, decorated borders in high relief, or flowerets of gold, were rapidly multiplied everywhere.

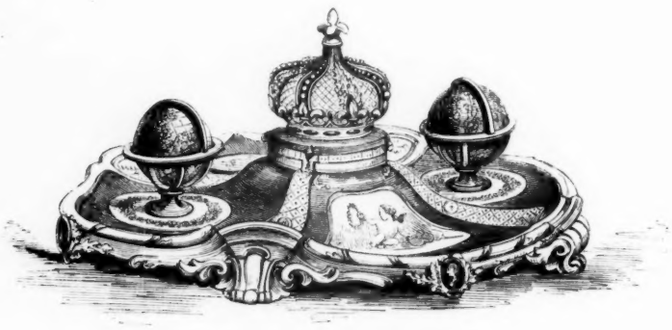
By a new order of council, in May, 1784, this efflux of forbidden works was arrested, and the second-rate manufacturers were forced to confine themselves to ordinary articles, destined for the table and for common service. They were allowed to gild borders and to paint flowers in all colours; but the porce-

VASE LIKE A MASTED VESSEL.
(In the Collection of the Marquis of Hertford.)

lain-workers were obliged to remove their furnaces to a distance of at least fifteen leagues from Paris. The resistance to these ordinances, however, was unanimous, and was so well supported by the friends of the threatened manufacturers, that ultimately things rested as they were.

Meantime the royal factory worked courageously. It called to its aid every variety of illustration available, and endeavoured to avoid allowing any repetition of its works to go out of the manufactory. It has been asserted that the form and decoration of Sèvres was tainted with bad taste, and a jejuneness which accelerated the decay of the art. But it was certainly not for the purpose of furnishing the small houses of great lords, or to supply the tables of courtesans, that artists could have been expected to dream of high art, and to surpass the style of the roofs and pier-glasses of Boucher, or the bold fancies of Fragonard, and of Clodion. Sèvres necessarily had to submit to the

law which subordinates the industry of furniture to architecture, and the art of interior decoration, and it knew how to preserve in its forms and paintings a moderation of good taste which must be recognized—in the piers, for example, to be seen at the Champ de Mars, or the Palace of Industry, or in the residence of the Marquis of Hertford. What a degree of originality there is in those vases of Duplessis, where four medallions decorated with Cupids sporting amongst the clouds, are detached on a fine green background, whilst elephant's heads in relief, with trunks uplifted, contribute to support over that elegant prédouche, the candlesticks, intended to hold four candles. Again, we must perceive the effect that would be produced on the royal table, by the culinary receptacle here illustrated, called *vase-vaisseau à mat* (vase like a masted-vessel.) The hull, with its false port-holes, detached, on a base of royal-blue, is finished with a fancy mask at each end, in the act of swallowing the stump of a mizen-



INKSTAND OF MARIE LECZINSKA.
(In the Collection of the Marquis of Hertford.)

VASE.
(In the Collection of the Marquis of Hertford.)

WAR VASE.
(Designed by M. Diéterle.)

mast, the main-mast covered under the chain-wales, hangs out the white flag sprinkled with fleur-de-lis in gold. The emerald green, the blue trellised with gold, surrounding the medallions, containing birds delicately painted, complete the delicious *ensemble*.

If, on the contrary, more energetic forms are preferred, contemplate the Falconnet vase, with its fluted shaft, and its garlands of laurel in relief, supporting medallions from which the paintings have been effaced by revolutionary terror.

Again, we may refer to the inkstand belonging to the Marquis of Hertford, as a model of elegance and stability. It was originally ordered by Louis XV. for Marie Leczinska, and this little masterpiece alone would serve to show the merits of the artists of Sèvres. On an oval platform, with a galley in rock-work supported by four consoles, and raised towards the centre, the ink-pot is supported, covered by the royal crown. The green surface of the plateau, cut in four by white bands quartered in gold, corresponding to the consoles, contains two medallions, on which are painted Cupids carrying crowns of flowers. Two other circular medallions at the ends, support two spheres, the terrestrial and the celestial, intended to hold the powder and the seals. In the gallery two small cartels give in relief the bust of the young Louis XV., and, at the two ends, the arms of France. This charming work, which bears the date of 1758, was used by two sovereigns. Marie-Antoinette, they say, applied it to her own personal use.

Then again, with respect to what was called the *garnitures*—the accessories—those rare pieces which were placed in gilt consoles, or in front of pier-glasses—look at the vase of the time of Louis XVI., belonging to the Marquis of Hertford. It may be thought rather exaggerated in its slenderness, but when we reflect that it is flanked by two pieces of less height, it becomes apparent that the general balance of the whole required this extreme lightness. What distinction there is, besides, in those godroons relieved by white pearls, in those enamels in relief which ease the surface of royal blue, and form a natural frame for the medallion in which is portrayed "Pygmalion at the feet of the statue!" Again, those delicate handles, enriched by acanthus leaves, without being overloaded, prove the tendency of that last epoch of French art, and its efforts to return to what is simple and direct.

We might multiply without end these examples of exceptionally good works, to be found in the collection of the Marquis of Hertford, Prince Hénin, M. Leopold Double, M. Beurdeley, Mademoiselle Grandjean, and the Marchioness of Fénelon.

But it is now time to say a word on painting, properly so called, and to explain the causes of its superiority for purposes of decoration, even upon the most skilfully executed works.

In many publications relating to porcelain the use of technical terms induces a considerable degree of confusion in the minds of readers unversed in technicalities. They speak of soft paste and hard paste, extolling one to the disadvantage of the other, without basing their criticisms on any principle, and, consequently, without clearing up the question. Sometimes it would appear that Saxony deserves to stand first in public estimation, because she first discovered the elements of genuine porcelain; at other times France is awarded the palm for the invention of her artificial pottery, which no doubt ranks high in the estimation of virtuosos.

To speak frankly—for dishes the soft paste is worth nothing; its varnish is easily scratched, and it does not well withstand sudden changes of temperature. But for vases, plates, candelabras—whatever is not intended for service on the table, and is not subjected to the contact of the knife, hot viands, &c.—articles in soft paste are incontestably superior to those in kaolinic porcelain. This superiority arises from the very defects of French pottery—its artificial paste is of a cream colour, upon which colours and gold detach themselves without crudeness; its vitreous varnish, fusible at very low temperatures, absorbs colour, incorporates it, and causes it to penetrate to the biscuit, conferring on it a degree of solidity and thickness, which may be looked for in vain in decorations on hard-paste; these are merely superficial, and are only attached by baking; for the glaze is infusible in the heat which fuses the colour, and thus there is no incorporation of the metallic oxides, which are fixed only by the flux.

The physical differences thus pointed out between the paintings executed on the two porcelains, are increased by the opposite principles on which they are applied. As already stated, the organizers of Vincennes and Sèvres were decorators. They sought less, perhaps, to perfect details, than to complete a harmonious whole. When we admire the plates painted by Dodin and Pithou the younger, in the house of the Baroness James de Rothschild, and representing the "Triumph of Beauty," and the "Toilette of the Sultana," we do not imagine that the tablets have gone astray in the panels of a delicious piece of furniture; we perfectly recognize the appropriateness of these two plates for the places they occupy—the gilded bronze, the veined wood frames them in, at the same time that they screen and complement the little monument of cabinet-work to which they are applied.

The secret of this harmonious sweetness is due, as we have said, in part to the complete fusion of the touch by the incorporation of the decorative enamels with the varnish; and in part to the method of painting, borrowed from water-colouring. There is no exaggeration of model, simple tones, relieved by lights, are judiciously employed; none of those blacks which make holes in a vase, and destroy its form; but instead there is a medium colouring delicately toned down, expressing very well both the process and the aim of the picture.

The Sèvres manufactures are distinguished above all by sculptures of the first order. Falconnet, famous for his figure of the "Bathing Woman," caused it to be reproduced in biscuit—a charming copy, which one might esteem even more highly than the original. The lover, known by the name of *Garde à vous*, formed, with the graceful young girl of the same height, ornaments all the more remarkable that they were placed upon sumptuous vases of porcelain. But the model preserved at Sèvres, known as the "Vase à l'Amour Falconnet," is exuberantly rich, with its consoles, medallions in relief, and garlands.

There are many other charming compositions, of which the authors are unknown to fame. For example, the group of "Léda," brought to light by M. Riocreux, and which is to be found in the cabinet of every man of taste.

There is one fact which must have had great influence upon French industry—the discovery of hard or real porcelain. Since 1709, Boettger had revealed the secret of it to Saxony. The other countries of Europe, and France in particular, were ambitious to gain possession of the secret, and sought, by every means, to rival the productions of Meissen. And that royal factory, transformed into a fortress, had already allowed some of its prisoners to escape; and one of them, James Henry Wackenfeld, a native of Anspach, offered to the magistrates of Strasburg to establish a porcelain manufactory. The first trials were fruitless, and, after two years of experimenting, the German workman had no alternative but to associate with himself, in 1721, Charles Hannong, proprietor of a large enamel manufactory in the town. Wackenfeld was very soon turned adrift, and Hannong continued alone the search for kaolin pottery. In 1726, he had so far succeeded as to offer to the corporation several pieces of porcelain of his manufacture. He died in 1739, before his fame had spread; but his son, Paul Antoine, succeeded to and continued his researches, and associated with him one Lowenfinck. The porcelain made great progress in respect of the paintings, which were much improved in execution. Pieces were bordered with violet fillets, and the surface was decorated with bouquets in Saxon style. The plates produced were perfectly acceptable, and promised to take rank with the best. But Paul Hannong and his sons got into trouble with the government works at Sèvres, and, after various negotiations, they broke up their factory at Strasburg, and removed, in 1754, to the Palatinate.

In 1758, however, the secret of the hard paste was discovered by Count Brancas Lauraguais, in the department of L'Orne; and, in 1765, Gueltard discovered the clay bed at Alençon. By experiments conducted in the laboratory of the Duke of Orleans at Bagnolet, a real porcelain was obtained, though rather of a brown tint.

At length, by an accidental circumstance, the Sèvres factory was enabled to obtain the desired material. Madame Darnet, wife of a surgeon near Limoges, remarked, in a ravine hard by, a white unctuous substance, which she thought would be suitable, instead of soap, for washing linen. She told her husband of the new material; and he, perceiving the importance of the discovery, caused some chemical experiments to be made with it, when he recognized in it the true kaolin. Trials on a large scale were made with success at Sèvres; and, in 1769, the Academy of Sciences were enabled to behold vases in hard porcelain turned out of the royal factory. The hard paste, once discovered and adopted at Sèvres, led to the execution of monumental pieces—such as gigantic vases, and large plates. The soft paste, abandoned on pretext of the unhealthiness of the manufacture of it, was given up.

At present, the want of a controlling mind at Sèvres is much felt. It is not a school, nor does it supply a standard of taste. However, since 1830, by the energy of Chevanard several remarkable works have been produced; and more lately, under the persuasion of a designer of talent and taste, Dieterle, monumental pieces have been produced, which have strikingly brought out the advantage of associating the sculptor and painter of the establishments—such as the "War Vase," here illustrated.

COAL AND COAL MINING.[1]

PUBLIC attention was for the first time, probably, drawn to the great and increasing demands upon our stores of coal, by Sir William Armstrong, who, in 1863, sounded the alarm over our diminishing coal beds, together with an extravagant consumption of coal, in his address at the meeting of the Institution of Mechanical Engineers, at Newcastle-on-Tyne; and though eminent colliery owners, as the late Mr. Nicholas Wood, did not, apparently, sympathise with Sir William, pointing confidently to the vast and unexhausted seams of coal extending under the ocean; the alarm, well-sounded, had a beneficial influence in directing the attention of the proprietors, as well as the consumers of coal, to more economical methods of getting and using it. The warning was not uttered before it was wanted. In 1863, the coal raised for the year was over 88,000,000 tons; in 1870, it rose to 117,000,000 tons. Those who recollect the steam-engines which were exhibited in 1862, at South Kensington, may have observed that, whilst, in a very few instances, English constructors showed a desire to improve the performance of the steam-engine economically, their engines in general testified to a feeling of absolute indifference to economy of steam or fuel, and probably in some instances to ignorance of the conditions on which economical coaling could be established. The manifest concern of the foreign exhibitors, on the contrary, to construct their steam-engines on economical principles was remarkable, and it was probably to be accounted for by the costliness of fuel on the continent.

But the generation and use of steam is only one of the functions of coal as a fuel, though it is a very important one. There are upwards of 100,000 steam-boilers in the United Kingdom, according to an estimate arrived at by the recent parliamentary committee on steam-boiler explosions, irrespective of locomotives and steamers; and the consumption of coal in stationary boilers alone, cannot fall far short of 40,000,000 tons annually, which forms a large proportion of the total of coal raised in Great Britain.

We cannot, without some degree of emotion, turn to the consumption of coal in the iron manufactures. We have known of 100 tons of coal consumed in the manufacture of a single armour plate, and we know of one iron-making establishment in Sheffield, in which 7,000 tons of coal are consumed weekly. In the matter of steam-boilers only, there are 150 of them in action at the same place.

Our mechanical philosophers condemn us and comfort us in the same breath, by the assurance that we waste, or at all events do not utilize, nine-tenths of the heat produced by the combustion of coal in industrial operations. Here we have ample margin for practising economy in the consumption of fuel; and, taking comfort from the reflection, as it affords grounds for hope of better things in the future, we turn to the well-timed volume before us, in which the question of coal and coal-supply is investigated in all its bearings.

Mr. Smyth opens with a chapter on the uses of coal, and informs us that coal cinders have been found amid the ruins of several of the Roman stations in Durham, Northumberland, and Lancashire, and also at Wroxeter. It was not, however, until the thirteenth century that we have clear proof that coals were systematically raised for fuel, when, in 1239, King Henry IV. granted a charter for this purpose to the townsmen of Newcastle-on-Tyne.

In 1306, coal made itself felt in London, when King Edward I. "prohibyted the burneing of sea-coale in London and the suburbs, to avoid the sulferous smoke and savour of the firing." The first mention of coal-mining in Scotland occurs in a grant executed in 1291 in favour of the abbot and convent of Dunfermline. Down to the end of the seventeenth century pit coal was employed for little else than household purposes; but the eighteenth century saw the use and partial development of the use of coal for making steam, chiefly for the purpose of raising water from mines. And, again, in the smelting of iron, Mr. Abraham Darby, about the year 1730, succeeded by the process of coking, in smelting iron with pit coal; and thus began the iron trade of Great Britain, which is one of the industrial wonders of the world. About the year 1803, another grand employment of coal,—for the production of light,—was initiated:

"For upwards of a century," says Mr. Smyth, "various experiments, and latterly on a manufacturing scale, had been made in the distillation of coal in order to procure tar and oils, whilst the application of the invisible gases produced was strangely neglected, notwithstanding attention had been called to the moderately lighting properties of the fire damp so largely evolved from many of the northern collieries. Soon after 1792, Murdock, the engineer in charge of some of Boulton and Watt's engines, suggested that the gas might be conducted through tubes, and employed as an economical substitute for lamps and candles. To light him on his homeward way over the Cornish downs, he used to carry a bag of gas under his arm, with a lighted jet before him, and tradition still tells of his frightening the superstitious miners whom he met in the dark, by a sudden squeeze of his bag, which threw out a long flame, taken assuredly for the fiery tongue of the arch-demon himself."

This incident of the birth of gas-illumination, reminds us of a similar story of the birth of the application of coal by Murdock, a few years earlier, for making steam to propel locomotives. He constructed a non-condensing steam locomotive of lilliputian dimensions, in the year 1784. It ran on three wheels, of which the drivers were only nine and a half inches in diameter. Notwithstanding these diminutive dimensions, this little gentleman managed to outrun the inventor. On one occasion the late Mr. Buckle, of the Soho works, Birmingham, related the following incident at the Institution of Mechanical Engineers: "One night, after returning from his duties at the mine (in Redruth, Cornwall, where he resided for some time, in charge of the mining engines), he wished to put to the test the power of his engine; and as railroads were then unknown, he had recourse to the walk leading to the church, situated about a mile from the town. This was rather narrow, but was kept rolled like a garden walk, and penned in on each side by high hedges. The night was dark, and he alone sallied out with his engine, lighted the fire or lamp under the boiler, and off started the locomotive, with the inventor in full chase after it. Shortly after, he heard distant, despair-like shouting; it was too dark to perceive objects, but he soon found that the cries for assistance proceeded from the worthy pastor, who going into town on business, was met on this lonely road by the fiery monster, whom he subsequently declared he took to be the Evil One *in propria persona*."

Again, in 1830, as Mr. Smyth informs us, the introduction and application of the hot blast in the smelting of iron gave an additional impetus to the raising of coal, for although by the use of the hot blast, the same quantity of fuel reduced twice as much iron, there was on the contrary a great increase in the quantity of iron manufactured. From 37,500 tons of pig-iron produced in the year 1830, in Scotland, the production amounted to 200,000 tons in 1839, and to over 1,000,000 tons in 1864.

In addition to the quantity of coal consumed within the United Kingdom, there is a large exportation of coal annually.

The following figures, supplied by Mr. Smyth, here quoted in round numbers, show in a forcible manner how rapidly the production is increasing, and how much goes out of the country to other nations.

Coal Production of Great Britain.

	Tons.		
Beginning of the century . .	10,000,000		
Year 1850 . .	42,000,000		
„ 1853 . .	56,550,000		Tons.
„ 1854 . .	64,661,000,	of which were exported .	4,309,000
„ 1855 . .	64,453,000	„ „ .	4,977,000
„ 1856 . .	66,645,000	„ „ .	5,880,000
„ 1857 . .	65,395,000	„ „ .	6,738,000
„ 1858 . .	65,009,000	„ „ .	6,529,000
„ 1859 . .	71,980,000	„ „ .	7,082,000
„ 1860 . .	83,209,000	„ „ .	7,413,000
„ 1861 . .	85,635,000	„ „ .	7,223,000
„ 1862 . .	83,638,000	„ „ .	7,695,000
„ 1863 . .	88,292,000	„ „ .	7,529,000
„ 1864 . .	92,788,000	„ „ .	8,064,000
„ 1865 . .	98,151,000	„ „ .	9,170,000

The coal excavated in 1865 would, it is estimated, if collected together, have covered the entire area of Lincoln's Inn Fields, eleven acres in extent, to a height of upwards of 5,000 feet.

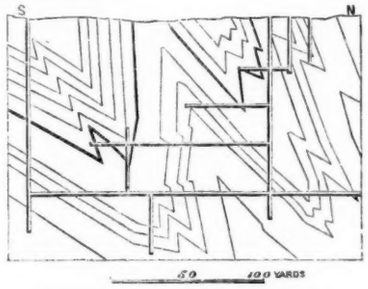
Mr. Smyth proceeds, in his next chapter, to a consideration of the mode of occurrence of coal, and he gives a clear and interesting *resumé* of the coal-measures. But, strange to say, there is a difficulty in defining exactly what constitutes coal. Mr. Smyth leaves it, in some measure, to common sense to say what coal is, though many thousands of pounds have been expended over the legal definition of the article. All he insists on is, that "we may fairly require of it that it be black or dark brown, capable of direct employment in furnaces or fireplaces for the production of heat, brittle, and not soluble in ether, oil of turpentine, or ben-

[1] *A Rudimentary Treatise on Coal and Coal Mining.* By Warrington W. Smyth, M.A., F.R.S., &c. London: Lockwood & Co.

zole." The troubles and anxieties that beset the coal-miner are not few, for,

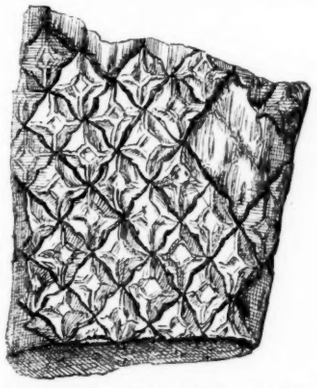
"In addition to this general disturbance from the original—more or less horizontal—position in which the beds must have been deposited, they have been cut through by inclined planes of fissure, and so dislocated that they are lower on the one side of the line of fault than on the other. The amount of *throw* or *leap* may be only a few inches or a few feet, in which case the workings are not much affected; but the movement may, in many instances, be shown to have arrived at hundreds, and, more rarely, at thousands of feet. A great number of these tumbles, within a small space, may render a seam of coal so 'faulty,' as to be worthless; whilst, if they are filled with clay, and suitably distant one from another, they serve a useful purpose in dividing a coal-field into water-tight compartments, and a jealous eye is thence kept on their security."

A striking example of the zigzag structure of coal-measures is seen in the accompanying section, borrowed from Mr. Smyth's work, of the mine, *Des Six Bonniers*, near Namur, in Belgium, showing the shafts sunk into the coal beds, and the levels branching from these shafts.



Section of the mine *Des Six Bonniers*, Namur.

In an instructive chapter on the organic remains that are found in coal, and on its origin, we are informed that traces of about five hundred different plants have been discovered in the coal-beds. Of the family of Lepidodendrons, which are beautifully marked, of one of which the annexed figure is an illustration, the



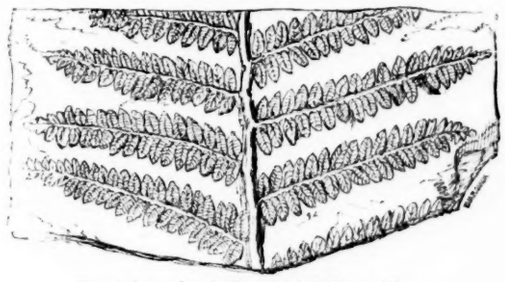
Lepidodendron obovatum (half natural size), Le Botwood Colliery, Shropshire.

trees attained a height of upwards of forty feet, and are referred to about forty species. The size is the more extraordinary when it is considered that they are classed by botanists with the *Lycopodiaceæ*, or club-mosses, the largest of which now living in tropical climates attains a height of only three feet.

The ferns adorn the shaly roofs of many of the coal-seams, sometimes clearly spread with their black tracery on a grey ground, as in the figure annexed, a true specimen of nature printing; in other cases tossed and tumbled in wild profusion throughout several feet of thickness of the roofstone.

Passing on to the formation of coal, considerable diversity of opinion has existed on the subject, but we must leave our author to speak for himself:

"Some years ago there were authors of weight who inclined to the opinion that coal had been formed by the drifting of large masses of vegetable matter into bays or estuaries, and they pointed to the 'rafts' of the lower Mississippi as examples of a similar process still in action. But, since due attention has been paid to the constant presence of the roots in the floor of the seams, to the upright trunks—often one series above another—and to the high state of preservation of the most delicate remains' it has been generally agreed that most of the appearances are explained by assuming that the vegetation grew on the spot where we now find it. Some writers there are who still have a hankering after the old aquatic origin, and, supported by the evidence of fishes and marine shells, would assign salt-water as a habitat for some of the coal plants. But, with others, the doubtful point is whether the trees and undergrowth flourished on dry land or swampy sea margins. We can no longer doubt that the underclay was a true soil, in which the great sigillaroid trees were fixed by their tap-roots, their spreading radical branches, and filamentous rootlets. How many generations of these trees may have risen to maturity and died away before the conditions were favourable to their being preserved, it is hard to



Pecopteris pteroides (half natural size), Forest of Dean.

surmise; but at length, when a mingled matting of vegetable matter, stems, roots, leaves, &c., had accumulated, like the pulpy mass of a modern peat-bog, the surface of the area was, with much uniformity, depressed. Then would flow back the waters, fresh or salt, over this ancient domain, and according to the sediment they were able to carry, would deposit sand or mud to be one day known as the rock, or the shale-roof. The *mollusca* above enumerated then burrowed in the soft ooze, close upon the top of the buried vegetation; in many cases the stumps of the old forest remained standing, whilst mud or silt was deposited around them, until the central portion of the trunk would rot away, serve for a time as an asylum for some of the lizards or land-shells of the period, and thus get filled in with petrifying matter. As the water deepened, it was haunted by fish of many kinds, whose exuviæ fell to the bottom, and were then buried up, and thus bed after bed of sediment accumulated, sometimes to the depth of a few feet, sometimes to hundreds of yards, if the continuous depression of the land was maintained, until circumstances favoured again the formation of a proper soil (the under-clay), and of a growth of trees and plants, when we should have a recurrence of the same phenomena.

"An enormous bulk of vegetable matter would be needed thus to form one of our thicker seams of coal; but we have seen how the latter are generally divisible into several beds, and these again into thin laminæ; whilst we know that peat bogs of the present day, without the special advantages of the crass jungle, attain depths of 30 or 40 feet. It has been estimated that eight feet thick of packed woody substance would be needed to make one foot of coal! but we may take it for granted that such an amount would represent only a fraction of the total amount of vegetation that flourished at the time, since much of it must doubtless have escaped from the preservative process of interment."

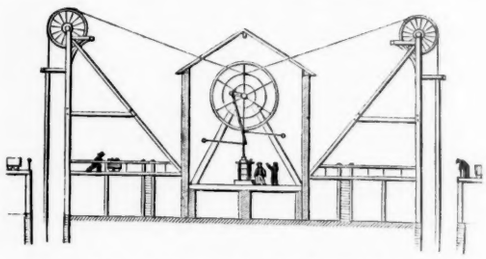
Mr. Smyth next reproduces a table from Dr. Percy's "Metallurgy," showing the successive modifications of the proportions of the chemical constituents of the vegetable matter, from the state of woody tissue to the extremely converted condition of anthracite, through the intermediate stages of peat, lignite, and coal, clearly showing that the constituent hydrogen and oxygen are gradually eliminated, leaving the carbon almost entirely by itself, in the form of anthracite.

"When the buried forest," concludes Mr. Smyth, "had once been fairly covered up by hundreds, and, as the land sank, by thousands of feet of rock, we may conceive it subjected to those conditions of pressure, temperature, and moisture, which were needed to change it into that condensed form of fuel now so necessary to mankind.

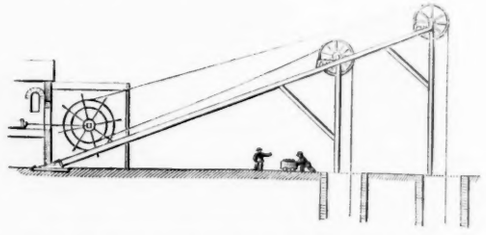
"And when at length, after ages of due preparation, portions of the coal formation were upheaved into islands and continents, the seams of coal were brought into a position to be accessible to man, and the forces of the sunbeams, which fell upon the jungles of the primeval world, are again unlocked and made subservient to our use, when we now decompose, by burning, those compounds which had been called into existence by the solar light and heat."

There are many facts corroborative of the theory of the origin of coal, here propounded by Mr. Smyth. The escape of choke-damp and fire-damp, or carbonic acid and carburetted hydrogen, from the beds of coal in mines, is evidence of a previously existing process of distillation and combustion, the commencement of which may be dated back to the time when the primitive vegetable matter was collected and placed under the pressure of thousands of feet of superincumbent strata. Under such enormous pressure, the water must have been filtered from the vegetable deposit, though it may be very slowly; at the same time that the temperature under which the deposits existed increased, in accordance with observations showing that the temperature of the earth increases as the depth below the external surface increases. A slow process of distillation was then set up in the mass, the effect of which was to remove the greater part of the volatilizable matter, the hydrogen and oxygen, of which a portion of the oxygen and of the hydrogen combined, if indeed they had not previously combined, in the proportions to form water, and another portion of the oxygen, combined with part of the constituent carbon, forming carbonic acid, whilst another portion of hydrogen passed off, in combination with another portion of carbon, in the various forms of hydro-carbon. This is not a merely hypothetical supposition; for we have the facts before us of the actual existence of carbonic acid, and light carburetted hydrogen, in coal-mines. Moreover, it is easily understood that water might have passed away through the superincumbent rocks, since we have in evidence the inverse process of water finding its way into coal-mines; and who knows but that this is partly a reflux of the water that had previously been expelled from the deposit?

After giving a succinct account of the various coal-fields throughout the world, Mr. Smyth describes the method of searching for coal:—boring, and sinking of shafts, driving of levels, cutting the coal, post and stall-work, long-work, conveyance underground, raising the mineral in the shafts, draining and pumping, &c., each of which important sections is clearly and practically treated. The annexed cuts illustrate the usual arrange-



Drawing Engine placed between two pits. Scale 1 inch to 50 feet.



Drawing Engine on one side of a pair of pits. Scale 1 inch to 50 feet.

ments of drawing engines. But we must pass on to the chapters on colliery accidents, and the duration of the British coal-fields. There appears to us to be some misapprehension as to the probable future rate of increase, as judged from the increase in past years. Naturally, when a fresh mineral is first brought into use, of which the good properties are readily recognized and appreciated, the extension of its use, when there are, as with coal, so many openings for it, must be abnormally rapid in the earlier periods of its employment. Mr. Smyth has sufficiently accounted for the rapid rise in the demand for coal during the first half of the century; and the demand, since 1845, for railway-bars, ship-plates, &c., has kept up in an increasing rate the consumption of coal. But, as air flows into a vacuum, at first with great velocity, and afterwards with a gradually relaxing speed, so it is in reason that the demand for coal will not be permanently increased at so high a rate of acceleration. Reverting to Mr. Smyth's data, on the annual coal-production of Great Britain, from 1850 to 1865, it appears that the increase for each year was successively as follows:—

Increase for One Year.

1850 to 1853	4,850,000	tons.	
„ 1854	8,111,000	„	
„ 1855	208,000	„	less.
„ 1856	2,192,000	„	
„ 1857	1,250,000	„	less.
„ 1858	386,000	„	less.
„ 1859	6,971,000	„	
„ 1860	11,229,000	„	
„ 1861	2,426,000	„	
„ 1862	1,997,000	„	less.
„ 1863	4,654,000	„	
„ 1864	4,496,000	„	
„ 1865	5,363,000	„	

From this it appears that the increase per year, taking a general view, does not itself naturally increase; and to suppose, as some persons do, that the production must go in a geometrical ratio, doubling itself every twenty years, because it happened to do so in the twenty years 1840-60, is to argue on premises quite insufficient. "On this view of the subject," says Mr. Smyth, "little more than a century would see this country utterly deprived of the mainspring of its mercantile greatness." We entirely agree with him that "the assumption is based on a fallacy, and that although the numbers for certain years appeared to fit such a conclusion, the increase of our production of from 2,000,000 to 3,000,000 tons annually, severe as it undoubtedly is, will keep us within comparatively moderate figures for a long time to come, and at all events defer, as regards the country at large, the evil day for two or three centuries."

Supplementing Mr. Smyth's statistics, we may add that the production of coal was 117,000,000 tons in 1870, or about 19 millions more than in 1865, showing an increase in production during the period 1865-70, of $3\frac{3}{4}$ millions of tons annually, which was less than the annual increase of the preceding three years.

We may add there is much, very much, to hope for from the utilization of small coal, almost entirely wasted till within the last few years. The waste in getting coal, as well as in transporting it, is enormous. The quantity of small thus produced is, according to Mr. F. C. Danvers, upwards of fifty per cent. of the whole quantity mined. Much of it is irretrievably gone—left behind in forsaken and forgotten workings. Commenting on the result of such a ruinous mode of proceeding, Mr. Smyth exclaims:—

"A miserable sight it is to see a part of a seam, the 'roofs' or 'benches,' as the case may be, when a parting becomes so thick as to prevent the whole group of beds from being conveniently worked together, abandoned and left uncovered; for, with the probability that when the present generation has died out, there will be no sign to show that there is still lying there neglected a tract of what at some future day might offer a profitable working. And intolerable again it is to observe corners and plots of ground sacrificed on account of the inconvenient division of properties on the surface; when often the avarice or inaptness of some holder of surface fields operates as a bar to the regular working of colliery proprietors, and of course as an obstacle to the development of the national store."

It is incredible, at all events intolerable, that under such circumstances no legislation has yet taken place to enforce the registry and preservation of complete mining plans.

Under every Mines Inspection Act, no doubt, every colliery proprietor is bound to prepare and keep up plans of his workings; but this offers but limited advantages, considering that at the end of a lease the plans are liable to be lost or destroyed.

We must refer our readers to Mr. Smyth's interesting volume itself on the subject of the utilization of waste coal. This is the central point of interest in the discussion of the magnitude and duration of our coal supplies. The work is full of sound and useful information, plainly and clearly communicated, and is illustrated with about fifty well executed wood-engravings. It will prove serviceable not only to the unpractised, but also to the practical man.

D. K. C.

CONCUSSION OF METALLIC BALLS.—A series of experiments conducted by H. Schneebeli, in which balls of like weights but different metals were dropped from a known height upon a well burnished cylinder of hard steel led to the following deduction: If different elastic bodies encounter concussion with one and the same substance, the periods of concussion will be inversely proportional to the square root of the co-efficient of elasticity of the various bodies.

INDUSTRIES OF SOUTH WALES.

THE industrial phenomena presented by the present condition of South Wales are of a very large and remarkable character. In no other British district is there a more rapid and ampler development of nature's resources, and there is not, perhaps, even in Lancashire, a greater immigration of population The peculiar configuration of the country, where the great seaboard soon developes ports for the export of the mineral produce of the hills and valleys, is the governing natural characteristic. Now coal, tin, copper, spelter, form the great materials for its industry. The great coal-field of the district is the most regular and perfect in the world. The western portion of this coal-field is as yet almost undeveloped. The great problem of the coal supply and coal trade of the future will as probably be worked out here as in the North. Cardiff is inferior to Newcastle alone for export trade in coal, while the social and industrial problems, as evidenced in the strikes of the present year, equally press for a solution. Several trades are passing through remarkable phases, and there is a development of new industries that have not received the attention they have deserved. It is to be regretted that definite information does not exist in fixed and easily accessible forms, and that the South Waleians are so absorbed in making money, that there has as yet hardly risen the class of men that diligently register facts, classify them, and expound their meanings and relations. Consequently information has to be sought through many varied sources. We will first endeavour to take a rapid survey of the ground, and may later endeavour to obtain a closer view of the details.

The industries of South Wales are comparatively modern. They lie within fixed limits and determined dates. The earliest industries of a country may generally be said to be its fisheries, and Suetonius tells a story that the Roman invasion of Wales was owing to the desire to possess the pearl fisheries that were then renowned. I have hardly spent more interesting hours than in watching men in their coracles on the Teivi, employed in catching salmon ; and I suppose that this industry of the present day reproduces very exactly that of a thousand years ago. At the present time anyone surveying the industries of South Wales will have immensely to enlarge his view. The fisheries of the Teivi and Usk, not unnoted, indeed, will sink into comparative insignificance. Not much will have to be said of the distinctive agricultural character of the western counties of Cardigan, Pembroke, and Carmarthen. The lead and silver-ore of this region would require to be separately discussed. Scenic beauty in these days forms part of the capital of a district, and though not favoured to so great a degree as North Wales, yet multitudes of tourists are attracted to such localities as Tenby, and the peninsula of Gower, the vale of Neath, and the rich scenery of the rivers. But attention would chiefly be concentrated on the great ports, Swansea, Cardiff, Newport, which are the outlets of the industries of South Wales, and beyond these to a series of lesser ports that are more or less struggling to the front, and behind these to the vast mineral riches contained in the valleys and mountains of South Wales. It is in this vast black region that the industry of Wales is mainly accumulated, that constitutes, in fact, its back-bone, from which our remarks will radiate, and to which they will principally return. Of late a sad universal interest has attached to it from being the seat of a most miserable and remarkable strike. The moralist, the legislator, and the minister of religion will all find abundant scope, and most plentiful material given to their use for shaping into nobler forms.

Let us first take a glance at the belt of seaboard and those numerous havens which send forth these heavy exports, the neighbourhood of which is not unfrequently teeming with manufacturing energy. These towns should be first specified, each of which would well afford scope for a separate article, each of which tells the story of South Wales, and foreshadows its future fortunes. These are Cardiff, Swansea, and Newport. In the immense expansion of the industries of South Wales, Cardiff has taken a prominent place. The prosperity of the town during 1872 was very great, many fortunes having been made that year. Indeed, Cardiff has been looked upon almost as a kind of California ; and it especially requires here to be recognized that fortunes have been lost as well as won. The late Lord Bute converted a wide stretch of moorland country into docks, his trustees carried on the work with immense energy, and the present peer is now engaged on new docks, and is said to be contemplating new docks beyond. He is now paying some sixteen thousand pounds a month for labour in the construction of fresh docks. The great want of Cardiff is an import trade. More than a million tons of shipping enter the port annually in ballast. What costly freights of raw materials and of consumable articles are suggested !—what ideas for the establishment of manufactories ! One great hindrance hitherto to the full development of Cardiff and South Wales has been the geographical difficulty. The two new schemes for crossing the estuary of the Severn, one by tunnel and the other by a bridge, should one or both be carried into effect, will go far to facilitate progress.

Many instances might be given of the way in which great incomes have been secured and vast fortunes accumulated during the rapid development of the country. One of the most remarkable of these shall be narrated. A man was one day in a penny steamer, plying between London Bridge and Westminster, and he observed the extremely small quantity of smoke issuing from the funnel. To speak of the smokeless coal of South Wales, is of course a misnomer. All coal has some amount of smoke, but the smoke proportionably lessens as the anthracite increases and the bitumen is diminished. The traveller was informed that the coal in question was procured from South Wales. He spent several days travelling up and down the river, carefully observing the characteristics of the fuel. Having convinced himself of its value he went down to South Wales, then in all his own resources, and collected as much co-operation as he could, and developed this particular branch of industry. The great coal merchant met with many discouragements ; his friends failed him, and he was forced to rely upon himself. He succeeded in accumulating a large fortune, and establishing a trade which is yielding a princely revenue.

But while the trade of Cardiff almost entirely consists of exports—in this respect Cardiff is the third port in point of tonnage in the kingdom—Swansea has an immense import business. The manufactures of Swansea are vast and increasing, but it is the want of manufactories that the merchants of Cardiff chiefly deplore. Swansea has made itself the great seat of the copper trade in Great Britain. The number of tons of copper-ore smelted annually in the kingdom may be estimated roughly at 200,000 tons, of which no less than nine-tenths are manufactured annually at Swansea. The town itself is comparatively free from smoke, but all the neighbourhood, though not much illumined with furnaces like the iron country, is overcanopied by gloom. The unique effect of the smoky valley will never be forgotten by those who have observed it. It is a great advantage for Swansea that it has a noble bay and close vicinity to the primitive and pleasant scenery of the Mumbles country. The town itself has not grown up a vast, undefined congeries, but has to some extent been laid out in pursuance of a plan. In addition to the copper-works there are extensive manufactories of iron, tin-plate, zinc, alkali, and earthenware, and the patent fuel of small coal, or culm mixed with tar, which is exported to a large extent. We have seen culm in constant use throughout Pembrokeshire and in adjacent parts. This is a composition of small coal, intermixed in agricultural districts with clay, which, if coal becomes scarce, will probably be brought into extensive use throughout the country. Some copper is brought into Swansea from North Wales, mainly from Anglesea, more from Cornwall, but it is mainly received from Australia, Cuba, and Chili, and to some slight extent from North America. Still the copper trade is not what it used to be, but for very many months past has showed a deterioration. The reason is that coal has been extensively discovered abroad. The copper frequently arrives in a partly manufactured condition, technically called regulus, chiefly requiring the later processes. The copper smoke used to wither all the verdure within its range, but now, by a patent process belonging, we believe, to Mr. Vivian, they acquire from it a kind of manure very largely charged with superphosphate of lime. The manufacture of chemicals is in many respects largely cultivated. There are large steel-works, in which an immense capital is embarked—works in iron, tin, spelter, and copper, in many of which no less than 2,000 men are employed. In the town and valley you may watch the whole process of tin-plate manufacture from the first blast of the iron to the manufactures of tin boxes.

We now work our way up from Swansea, following the sea line, towards Chepstow. Neath, on its river, surrounded with hills and valleys, has the mineral wealth that guarantees the increasing prosperity of the town and district. Its port is Briton Ferry, already furnished with docks and railways, and developing a young but prosperous career. Similarly, Bridgend has its manufactories, and its coal and iron-mines, and an outlet for its commerce in the port of Porthcawl. Aberavon, or more properly Port Talbot, as it is called from the Lord of Margam, conveys coal and iron to and from the neighbouring works. Newport must be claimed as belonging to South Wales. Geographically it is English ; Monmouth being one of the forty English counties, but upon every other point of view it is strictly Welsh. Canals and railways bring down to Newport the wealth of the

mountains, and in the town itself there is a rapid growth of trade and manufactures. Newport possesses an extraordinary facility for the expansion of trade, the geographical position being highly favourable. It is the converging point of the valleys of the Usk, Avon, Ebbw, and Sirhowy rivers. The Usk at Newport is navigable for ships of the largest size. There are at present in the course of construction the new Alexandra docks, in addition to the docks which were completed in 1842, and those which were commenced in 1858. The town is the meeting-point of no less than five lines of railways. There are two great canals, one running up to Pontypool, Abergavenny, and Brecon, and the other accompanies the western valley railway. These canals have tramways, and some of the tramways have tunnels of considerable length, which convey iron and coal from the various works. Cardiff has, however, diverted a good deal of the trade that would naturally fall to Newport, as Cardiff had the advantage of the forethought, capital, and the single determining mind of the late Lord Bute. Newport, like New College, at Oxford, is a very old name. It serves to distinguish the new town from the ancient city, three miles off of Caerleon-upon-Usk, once the famous seat—with theatres, palaces, and temples of the second Augustan Legion, and the famous localities, half historical, half legendary—of Arthur and his knights. Newport has earned a more authentic and sadder page in modern histories, by the Chartist riots of 1839, which nearly rose to the dimensions of a rebellion. Many of the inland towns have their one striking industrial history, such as Merthyr-Tydvil, Aberdare, and Maestegs, in its wild isolated valley. Near here, and within a few miles of Bridgend and Porthcawl, are the great Tondû works of the Brogdens, who were the first to close the great strike, on the old fashioned and excellent plan of meeting a colourable demand half-way.

We must penetrate a little into the interior, in order to understand the nature of the ground. It is worth while looking carefully at the outward scenery, the external phenomena of these crowded seats of industry. There is hardly a more interesting and instructive journey than that which can be taken from Cardiff on the Taff Vale line to any of its four termini. This is one of the richest lines in the kingdom. In their present returns for the spring quarter the gross receipts are double the gross expenditure. It has had a strange history. Original shares could at one time be had for a mere song, contemptuously refused when proffered in payment of debts. There is now not a better-paying line in the kingdom. It is quite worth while to take the journey for the unique series of scenes that it displays. You soon get from the level alluvial plains to the mountains. The streams hurry down the hill-side with a force and freshness peculiarly their own. The river, however, rolls black over the pebbly bed, and the angler has the scantiest of hopes there. Vast hills tower grandly into the sky, and villages are gathered at their base, or oddly enough, hang halfway on their sides. You pass rapidly monstrous mounds, tramways, huge masses of *scoriæ*, pit-shafts, cinder-tips, occasionally a village spire, and Bethels and Bethabaras without number, and you constantly hear the roar of the furnace, the clangour of the engine. The immediate atmosphere is hot and dusty, the water before you sooty and viscid, the dwelling-houses are crowded, poor, and mean, and the publican drives an ever-thriving business. It is astonishing, however, how soon you may steal away to sylvan or mountain regions, to living airs and living waters. Some persons even suppose that coal is a modern discovery. Yet, when we find cinders in ruined castles, in castles that have been ruins for hundreds of years, it is not unnatural to suppose that their feudal lords were acquainted with the use of coal. Going still further back than that, it is a fact that the tomahawk of some aboriginal was found buried in some Monmouthshire strata. Many curious archæological points might be mooted in connection with the history of iron. The Sussex adventurers came here in the sixteenth century, but they do not seem to have achieved anything. It is not till the middle of the eighteenth century that we obtain any regular account of mining operations. They seem to have been simple in the extreme. Iron was obtained from the bed of the Taff, and afterwards by flushing it. Little children collected boulders in their hands and sold them for half-pence. The beginnings of coal-mining at Aberdare and at Dowlais were excessively primitive. Coal was collected "on the crop," as it is called, lying close to the surface, and was cut patchwise. It was not then used in the making of iron, the necessary fuel being obtained by cutting down trees. The coal was therefore sold at a half-penny a sack to such poor people as needed it. Many of those sacks were carried over the hills and retailed at seven-pence each. Wood-cutting was resorted to for many years for the fuel in ironworking. Once a-week the men used to take a holiday for the purpose of cutting down a sufficient number of trees to serve them for their five days' work. Other accounts say that the week was divided into equal portions of wood-felling and iron-making. In the neighbourhood of Dowlais there was one John Guest, the founder of a great and wealthy house, who exchanged sacks of lime for sacks of coal. From such slight beginnings expanded this mighty trade in minerals. When we come to define the localities we may say roughly that the works are conglomerated into a set of nine or ten valleys. From the central chain of high moorland, separating the counties of Monmouth, Brecon, and Glamorgan, numerous valleys run off at right angles towards the south. These valleys are separated from each other by moorland and hill, now often tunnelled by the railways, and on heights some thousand feet above the level of the sea the iron-works are found surrounded by a great and teeming population.

In the middle of the last century a large extent of land, teeming with mineral treasures, extending for six miles from the top of Dowlais, was leased by the Dowager Lady Windsor to one of the Tredegar family, Thomas Morgan of Machen Place. Morgan wanted it as a hunting place, the Dowlais heights being famous for black grouse, but a clause permitting the lessee to work coal sufficiently indicates its mineral character. The lease was for ninety-nine years, and the rent £26 a year. A portion of this ground was subsequently sublet for £50,000 a year. However, we are anticipating matters. Morgan, being tired of the shooting, was willing to rid himself of this strip of land. The story is that he sub-let it to a farmer named Lewis, who repented of the bargain as soon as it was made, and had no peace until he obtained his desire of having it rescinded. He had no idea that, for a while, he held the purse of Fortunatus in his grasp. A descendant of this Lewis used to be pointed out as a publican in a small way of business, selling beer to men on lands which might have been his own. The Dowlais lands were eventually transferred to another man named Lewis, the earliest iron-master in South Wales. Then came a man named Guest, from Bromley in Shropshire, who gave up a small business which he had of his own to manage the works at Dowlais. Only a dozen years ago there was an old lady residing at Merthyr who remembered this John Guest very well. He was a plain, homely man, the only Englishman in the district, and would sit on a boulder opposite his solitary furnace and read intently the weekly newspaper, which she brought him from Brecon. Guest throve and became a partner in the works, and eventually his family held the largest share in the Dowlais iron-works. The Dowlais posterity eventually procured a baronetcy with the magnificent estates of Sully Island, and the manors of Canford and Wimborne. Another great iron king was Anthony Bacon. He came up from London in consequence of the gradual news of the iron in Wales, and he leased a tract eight miles long and five wide, known as the Cyfartha estate. The lease was for ninety-nine years at £200 a year. He had to bring some little capital into play, however, by buying up the rights of some small farmers who held leases for the soil. He gave them about £100 apiece, and the small Welsh farmers, who had never seen so much money in their lives, muddled it away in drink, and then hired out themselves and their litter-carts to the ironmaster to convey his coal and fuel. Bacon held important government contracts, especially one for making cannon during the American War. The iron was carried down on the back of mules to the creek of Cardiff, constituting the earliest important trade of that great port, and the place was long known as Cannon Wharf. It was alleged against Mr. Bacon, however, that he was a man of cosmopolitan feelings, and supplied the Americans as well as the British, and, consequently, the contracts were transferred to the Carron Iron Company in Scotland.

Bacon made his money, and disposed of his Cyfartha works. Eventually Richard Crawshay took Cyfartha. He was the son of a small Yorkshire farmer, then an assistant in a London ironmongery business, afterwards an adventurer in Wales. Few men have left a stronger personal impress on the industry of South Wales than this Crawshay. He is represented as a stalwart Englishman, standing like a Colossus in front of his grimy house, with his hands deep in his capacious well-lined pockets. He swore heavily at his men, but they liked him, and he knew that they always wished to give him fair play. Cyfartha was a very nursery of great ironmongers. Richard Hill, who had been manager under Bacon, took to the Plymouth iron-works, of which the land had been leased from Lord Plymouth. George Crawshay started the tin-plate works in Monmouthshire. Wayne established the works at Nantyglo and Aberdare. Benjamin Hall made a large fortune, and his son was ennobled under the title of Lord Llanover. Altogether William Crawshay bequeathed £8,000,000 sterling to his descendants, perhaps the most colossal fortune of our times. But the foremost of all was Joseph Bailey, and with him his brother Crawshay Bailey. The story was that a shoeless lad, cap in hand, came one day to Cyfartha, and claimed Crawshay as an uncle. The ironmaster allowed the claim, questioned the lad, liked him, gave him a

room in his house, and a place in his office. He subsequently started him with the means of making a great career. That boy became Sir Richard Bailey, famous not only for his works but for territorial possessions. "When he died," says a local print, "he was among the foremost men of his time. It was his delight to say that as far as he could see the setting sun the land was all his own. He held great tracts of land in Breconshire, Monmouth, Glamorgan, Hereford, Radnor, and other counties; possessed six mansions and their estates in Breconshire alone; the ancient domain of Llansmawr in Glamorgan; was chairman of the Birkenhead Dock Company; patron of six livings, and died worth, it is estimated, four millions of money." The present Mr. Crawshay maintains his ancestor's reputation, and is popularly known as the Great Iron King. Mr. Crawshay employed at the time of the strike about five thousand men. In that strike he certainly showed his determination when he blew out his furnaces and brought his horses from the pits to sell them.

There is quite a political history belonging to these districts. During the present strike the workmen have been remarkably well-behaved, and the magistrates have had an exceptionally easy time of it. They have recognized that they must seek to achieve their object by combination and discussion. But they have been brought to this wholesome state of mind by rather severe discipline. Occasionally scenes have visited the district very much like civil war. The conclusion of the great war brought bad times all over England, and led to the reduction of wages. The Monmouthshire men rose up amid their hills, and marched upon Merthyr Tydvil, stopping all the furnaces in their way. At Merthyr there were hosts to co-operate, and there were free fights in all the dirty streets. A great body of men were pouring down the hill at nightfall, and the owners of property and peaceable families felt that they had much to fear. Special constables, pikemen, and even the country yeomanry have been proved on well-contested fields to be inferior to the brawny miners of the hills. The masters agreed to meet the miners at the Castle Hotel, but there appeared to be little chance of fair argument. There were angry eyes and gleaming pikes among them. The only hope was in the arrival of the military. The keen-sighted ironmaster, Meyrick, saw that they must gain time. "Look here, boys," he said, "while your friends and the masters are settling matters, we will give you some beer and bread and cheese." Such a proposition is always pleasing to a mob, and men with bludgeons and pikes temporarily disappeared. On their return the points of vantage had been seized, and the military were pouring in from all quarters. Some historical regiments were only represented by raw recruits, but there was one regiment, fresh from the field of Waterloo, that attracted attention and imposed awe. They are described in the Merthyr local history as veterans, with eyes flashing like their own swords, exhibiting that cruel gleam which is seen in war.

The year 1831 was a landmark in the industrial history of South Wales. It was a year of great political agitation, and the back waves were felt far in South Wales. Trade unionism made its appearance among the miners. The public-houses had their select rooms for secret societies, and signs and watchwords became frequent. The summer of that year was one of the longest and loneliest ever known, destined, however, to close in suffering and sadness. The times were bad, the demand for iron slight, and it was impossible that the ironmasters should give good wages. They were on the eve of good times, the eve of great railway expansion, but the good time was not yet. There came an arch-agitator named Twiss, who not only frequented the political publics but had the use of some of the chapel pulpits. The strike spread rapidly, but Twiss kept up the spirits of the men by promising that waggons of silver were on the way to their relief. The money never appeared; but Twiss vanished, and has been supposed to spend the gilded evening of his days in some pleasant suburban villa. A really pleasing strike happened in the time of the great Bailey. It was necessary that a reduction of twopence or threepence a ton must be endured, and there was a strike for three months. Then the men cowed. But in the very moment of victory Bailey gave them the concession which they wanted. Times had amended in the interval. "No, no, my men," was his answer, "go in to work; things have turned out better than I expected, and you shall have the old prices."

On the merits of the trades' unionism question we will not now dwell. There is no doubt but the unions have achieved some substantial victories. They have added, as the *Times* once put it, a clear shilling a week to the wages of some five millions of men. Such colossal fortunes as we have named might have afforded more, and perhaps the workmen might have afforded to take less. It may be questioned, however, whether they have gained a shilling a week in education, in the comforts of home, and in the enjoyments of life. The increased wages have caused men to abbreviate the hours of labour, and to indulge in luxury and drunkenness. At the same time the experience of 1831 taught a terrible lesson. The riot act was then read, the military called out, and though only one poor fellow was hung, yet many houses in Merthyr had its killed and wounded. The Merthyr people became thoroughly ashamed of their violence. In after years, long after any fear of penalties had passed away, no one would ever own to having had a hand in the Merthyr riots. Any one who had been there was only present as a boy or as a mere spectator.

In looking at the vast agglomerations of men in this great seat of industry we have to take care not to be misled by any statistics of immorality. A very keen kind of intellectual life is developed in such crowds. The presence of the chapels would alone attest this, although chapels have been unnecessarily increased, to the weakening of the sacred interests involved. For music and eloquence the Welsh are born with a natural gift, and the gift finds abundant vent in these crowded districts. A long list of distinguished men might be compiled from this black country's rising from lower social strata to statesmen and judges. It is to be regretted that for many years past there has not been that personal intimacy and kindness existing between employers and employed that marked the earlier decades of the century. The impulsive and affectionate-hearted Welsh would keenly feel any difference in this way. A kind of feudal attachment lingered in Wales between owners and workmen, long after workmen had everywhere degenerated into mere hands. So thus it is that a moral element—a human element, enters into every conceivable combination of circumstances, and, when this is lost, their deranged material interests are inevitably thrown altogether out of gear.

PATENT PEAT-CONDENSING MACHINERY.

By Henry Clayton, Son and Howlett, Woodfield Road, Harrow Road.

AT a time when best Wallsend coals are selling in London at the rate of fifty-two shillings per ton, it is but natural that the attention of scientific and practical men should be turned to what other supplies of fuel exist in the country, and although we are promised by the New Gas Company a wonderfully cheap agent for the production of steam, it has not yet been used to any extent, and we are still *de facto* confined to coal, wood and peat, possibly some people might care to add to these petroleum, but its use as a steam-generator, is also yet in its infancy. The price of the first-named has lately risen so much, that it has passed almost beyond the reach of many of our small manufacturers, as well as become too dear for the consumption of a large proportion of the poorer classes, who have thus been put to no small inconvenience and suffered no little hardship during the late inclement weather. As to the second, it has long been known that save in some isolated instances, it is far too valuable as a material of construction, and far too scarce an article to be used, in England, at least, as fuel; and there then remains to us only the third, "peat;" to the consideration of the deposits, cutting, and preparation of which we propose to devote the present article.

By some authorities, the deposits of peat in Great Britain and Ireland are stated to cover an area of not less than six million acres, in depth varying from two to forty feet. We are ourselves inclined to think that this is rather an over-estimate, and that from four to five million acres would be nearer the truth; there is, however, this to be said in favour of the higher figures, that there are doubtless a large number of small bogs in various parts of the kingdom which have never been included in any calculation, but whose existence ought not, in any fair averaging, to be entirely ignored. The great difficulties which lie in the way of a general adoption of this fuel, are, first, the immense proportion of hygroscopic and fixed water which it contains, and which when it is freshly cut, may be said to vary from 35 to 80 per cent. of its weight; secondly, that of breaking up the cellular tissues which contain the fixed water; and, thirdly, the cost which the handling of such large quantities, admitted in the process we are about to describe, to be five tons of raw peat to one of condensed fuel, places as a permanent charge upon the latter. Many and varied have been the attempts which inventors have made to free peat from its moisture, and so reduce its bulk as to fit it for cheap transport, and there are, besides those in which machinery is employed, some very primitive methods adopted by the inhabitants of different countries. In some parts of

Europe after being cut, it is laid out on the sward to a depth of from eight to eighteen inches, by a breadth of four or five feet, and in any convenient lengths ; it is then brought into a homogeneous condition by working with harrows and spades, or the kneading of men and animals, until it becomes of the consistency of stiff mortar, when it is left for two or three days, according to the state of the weather, to dry. It is afterwards trodden over by women and children with flat boards, about six by twelve or fourteen inches, attached to their feet ; and eventually it is cut into pieces of any desired size, and, after being turned over once or twice to facilitate drying, is packed away (not, however, too closely), until required for use. In Sweden, some peat from which country was recently successfully tried on one of our river steamers, this fuel is, according to one of our daily contemporaries, prepared in the following manner :—" The peat fresh from the bog is put into a hopper which feeds a sort of disjointed blade-like archimedean screw, working within a closed cylinder with a conical end ; here it is worked into a sort of dough or coarse pulp, the pressure of the screw causing it to exude from the conical orifice ; a knife worked by a cam cuts it off as it does so into blocks about three inches in length ; these are carried over by a travelling arrangement to the ball-forming machine, which is a sort of bell-shaped affair in which the spherical form is given to the block by rotary motion. The balls are next run into a drying shed where they are dried in large trays without artificial heat, the air drying them without cracks or openings of any sort. The balls, when thus finished, are hard and dense, and in a very convenient state for use. In domestic houses, they make a very cheerful fire, and for steam-engines, for warehouses and other places where intermittent work is the rule, the peat fuel will be found, we have no doubt, both useful and economical."

Another simple process, common enough in Holland and Ireland, is to manipulate the peat in its wet state, and form it into blocks of a more or less uniform size, which are then laid out to dry until they become of sufficient consistency to be stored for further desiccation and eventual use ; this is called *hand* peat, and is highly esteemed, but it will readily be perceived that with the best of arrangements, and even in countries where, from their poverty, labour is cheapest, such a system must be unequal to the preparation of the large quantities required for mercantile or manufacturing purposes. In proof of the universal importance of the economical and rapid preparation of peat as fuel, we may mention that the engineer-in-chief of the Steam-Ship Company of the Netherlands, where peat bogs are extensive, has made a special visit to the Atlas Works to make arrangements for working the patent of Messrs. H. Clayton, Son, and Howlett. Turning again to peat-cutting and preparing machinery, we find that in North Prussia the system of Brosowsky has been in use. It consists of a cutter made like the four sides of a box with oblique edges ; which by its own weight and by means of a crank and rack-work, operated by men, is forced into the peat to any desirable depth. An open face must, however, have been prepared for it, and when it has penetrated sufficiently, a spade-blade by means of levers, is driven under the cutter, and the then enclosed mass of peat loosened. By this machine it is asserted 31,000 cubic feet of peat can be cut, and laid out by four hands per diem. Passing over an arrangement by Lepreux, for dredging the peat which sometimes exists as a paste or mud, we come to the machine of Mr. C. M. Williams, of the Cappage Works, whose system was to break up the fibre of the peat as much as possible, and then place it under a pressing machine, where it was reduced to one-third of its original volume, and lost about two-fifths of its weight. At Maunhart and Neustadt crude peat has been passed through rollers and delivered to the drying sheds in soft blocks. Mr. Charles Hodgson has also invented a patent process for producing from dry powdered peat, a really good article of fuel. The system followed was that of allowing the desiccated peat known in Ireland as mull to fall into a horizontal reciprocating ram, working in a cylinder five feet long, the peat dropping in as the ram draws back at each stroke, which in its return exerts such a pressure that the blocks were delivered from the other end at a density equalling that of coal, the output being at the rate of 15 cwt. per hour.

The main features of Mr. Hodgson's patent are clearly that by prior drying of the peat the expense of handling, in the after processes, some 60 or 70 per cent. of water is avoided ; but against this it must be acknowledged, as self-evident, that at some stage or other of the operations this quantity of water *must* be moved and the question resolves itself into this, whether the drying can best be done after or before the manufacturing ; Messrs. Henry Clayton, Son, and Howlett have decided that the latter is the more feasible and economical, and although the foregoing is far from a complete sketch of the different systems of preparing peat proposed, it yet embraces the most distinguishing features of the various inventions, and we now proceed to a description of the Messrs. Clayton and Howlett's patented arrangements.

The raw peat when dug is placed in what are called squeezing trucks, having perforations at the bottom or sides for the escape of the free water, which is forced out by the action of a piston operated against the peat by a screw or lever, and by the time these trucks reach the machine a considerable portion of this free water is thus expelled. The machine for masticating the peat consists of a vertical hopper in which is a revolving shaft, carrying a series of screw-blades, and on the crude peat from the squeezing trucks being fed into the hopper, it is, by the action of these blades, broken up and forced downwards into a long horizontal cylinder.

This cylinder, which is really the main portion of the machine, has, passing through its centre, a revolving shaft armed with propelling screws ; whilst a series of discs are also so arranged upon it as to form a dissected double screw. At the end furthest from the hopper of this cylinder are fitted cutting-blades of hard steel, between which pass the discs as they revolve. The combined action of these blades and screws causes the peat, as it is carried along by the discs in their forward twisting movement, to be brought against the cutters, and thereby effecting a thorough mastication or trituration, by which all the cellular and fibrous processes are thoroughly disintegrated, the fixed water set free, and the peat reduced to a pulp of an uniform homogeneous condition.

From the end of the horizontal cylinder it is then forced out, through orifices of any section that may be deemed desirable, in continuous streams, on to a portable lathed tray upon which the peat travels to a point where, with a set of wire-cutters on a frame, a boy cuts it into suitable lengths, and it is then taken to the drying sheds, where, in about three days, it becomes sufficiently dry to allow of its being removed to, and stacked in open racks of a somewhat special construction, where the drying and consolidation are completed.

If we hesitate in any way, after the satisfactory tests that have been made, in accepting this process as a complete success, it is simply on the question of cost ; for, as regards the finished fuel, it is unquestionably an article of the very first quality. We were assured by the patentees that the cost of their manufacture does not exceed from three and sixpence to five shillings per ton of the compressed peat, but when we come to recollect that to produce 15 tons of this article 75 tons of the raw material must be manipulated, carried to the machine (the cost of the pressing-trucks and tramways will also form no inconsiderable item in the cost of plant), handled again in the drying-sheds, and, at all events, moved *once* in them, we certainly are inclined to doubt, unless labour be exceptionally cheap in the localities fixed upon for the factories, that the sum stated will cover the outlay. This, however, must be a matter for actual experiments, and we have reason to believe that many landowners in different parts of the United Kingdom and Ireland have already arranged to give Messrs. Clayton and Howlett's machines a trial, and we need scarcely add, thinking, as we do, on the importance of any addition to our fuel supplies, that both they and the patentees have our best wishes for success.

MACHINERY OF LONDON LIFE.

II. London Food Supply.—Imported Foods.

THE time-honoured winter wail, that "never were there harder times for poor folks than now," seems at last to be amply justified. Bread is dearer than it has been for years, house-rent—at least for Londoners—never was so high, coals have attained a price that makes their playful designation of "black diamonds," something more than a joke, while as for butcher's meat, the least, for patience sake, that is said on the subject the better.

That this just now is the popular opinion there can be no doubt, and truth compels one, however unwillingly, to endorse it—excepting in one particular, as regards butcher's meat. If we admit the justness of the sentiment that the least said on that disagreeable subject the better, it can only be on the principle of extremes meeting. The fact is that the flesh of the ox and of the sheep in the London market, so far from being at famine price, is extraordinarily cheap. It is a well-ascertained and established truth, and patent to all except those who obstinately shut their eyes to it, that mutton and beef of a splendid quality, and in any convenient quantity, may now be purchased by the working man at

a rate that will enable him and his family to partake of a comfortable dish of it every day of his life. Nor need he, if he be an "advanced" working man in receipt of eightpence or ninepence an hour as wages, be restricted to beef and mutton. At a price fairly within his means he may regale on rare dishes and dainty preparations, such as his father and grandfather never dreamt of. He may obtain soups of all kinds, and ready to his hand, jullienne, mock-turtle, mulligatawny, maccaroni, and vermicelli, and if he be nice as to his beef, he may vary the dressing of it almost as often as he pleases, and ring the changes on boiled, roast, spiced, corned, seasoned, brisket, alamode, minced, and stewed; in the way of mutton he may have it boiled, or stewed, or smoked, or spiced, or minced, or roast, or hashed, or haricot, or in shape of a handsome mutton ham, cured either with honey or sugar. At a little extra expense, for Sundays and festive occasions, he may "go in" for real luxuries and rarities, roast duck and green peas, boiled and roast turkey, curried rabbit, roast and boiled fowls, ox tongues, and Kangaroo, in form either of ham, venison or tail soup. There is no stint of these good things. Those above mentioned, and at least fifty more, can be supplied to an extent that twenty times exceeds the present demand. It is merely ordering a shipload, and straightway they are here.

But it is the fatal word "shipload" that in the foolish eyes of the thousands, and tens of thousands who should be partakers of this cheap and generous fare, destroys the charm, and turns their mouths watering into wry face making. They will have none of it. They have heard all about it before, they have read all manner of advertisements respecting it, as well as the glowing accounts printed in the newspapers, of banquets, composed entirely of these imported things, and of how good those who sat down to them found them. They have seen the tins in which they are contained exposed in the shops of the grocer and the oilman, and they have remarked the extraordinarily low price at which they were marked, especially those common-place essentials, beef and mutton, as compared with what the butchers were asking at the same time for the same meats in an uncooked state. They know all about it; it has been dinned into their ears a hundred times, but once again,—no. It is true that they, the wrong-headed ten thousand, never tasted the beef or the mutton, or the soup, or the butter, but "they know them that have," and how mysteriously "foreign flavoured" they were found and that is quite enough. Nothing shall ever tempt them to invest so little as a shilling in an Australian "tin." No matter though English beef is realizing a shilling a pound, and a very small joint of it falls to the share of the labouring man, it *is* English beef and not some "mucked-up" rubbish got together by people that live at the other end of the world for the British market. The same with the butter, and everything else that is offered for sale at such monstrously low prices. It may be all very well for paupers in workhouses, and for felons in prisons, but the free and independent British workman always *has* done without these kind of things, and is not now to be wheedled into adopting them.

It has always appeared to me a mistake on the part of those who are financially concerned in elbowing for their preserved meats an established position in the London market, that they should endeavour to do so by providing free dishes of it for the consumption of paupers, and those who live chiefly on charity. In the first place, it is capital unprofitably invested. A hundred pounds may be sunk in giving a free dinner, say to a thousand of the poor of a squalid district; but a hundred pounds worth of benefit will never accrue to the investors out of the transaction. The more lavish the generosity of the givers, the smaller will be the appreciation of the gift on the part of those amongst whom it is distributed. I have heard them say, "It is all very well to call it charity, but its only a trade dodge to get the stuff known. It costs hardly anything, and they can afford to throw a few cans of it into the water as ground bait, to gather the fish they mean to hook as buyers of it at sevenpence or eightpence a pound." The very circumstance of the invitation to "come and eat and tell us what you think of it," being so earnestly pressed, of itself is sufficient to create a prejudice against the new food in the minds of the very ignorant, and the Cow Cross costermonger, who for the first time in his life sits down to a smoking mess of Australian meat experiences in some degree the feelings of the man who first found moral courage enough to open and swallow an oyster. He forgets that the intention is to appeal to his hungry belly, and consults only his fastidious palate, and draws a comparison between the canned mutton and an especially fine leg of the same meat it was once his good luck to taste a slice of, and forms his judgment accordingly. Not that the introducers of Australian cooked food lose much by this. It would be just as profitless, as far as they are concerned and as regards securing the patronage of the working classes, if the partakers of these gratuitous "feeds" spoke loudly in its praise. The artizan class, on which the success of the meat-importing scheme in the main depends, is not apt to be influenced by any recommendation that comes in such a form. The bricklayer, the carpenter, the engineer, are each in receipt of fair wages, and a man too nice in their notions as regards social distinctions, and he is by no means the more inclined towards tinned beef and mutton, because he so repeatedly reads in the newspapers that it has been "tried" in this workhouse and that prison, with the gratifying result that while half the hitherto cost of meat has been saved, there has been no observable diminution of health amongst those who have been compelled to eat it or go without meat entirely. The working carpenter, earning six-and-sixpence a day, is *not* compelled to eat this kind of meat or none at all, and to his not invariably unprejudiced mind the fact that such scurvy experiments have been tried at the establishments named, taints every can in the kingdom with a pauper flavour, and sets a House of Correction brand upon it, which, all wholesome and innocent as it is, is a grave injustice.

At the same time it would be a great national achievement could a means be devised for breaking down the blind and obstinate prejudices against Australian importations that possess those who should be foremost of all to avail themselves of them. All that need be done is to make the *truth*, pure and simple, thoroughly well-known. In the first place, as regards the most important items of Australian contributions to the food supply of Great Britain, beef and mutton, the popular delusion is that the animals that supply the meat are "foreign" animals. This is not the case. There is no such thing as "native" Australian stock. The millions of horned cattle that at the present time grow sleek and prosper on Australian pasturage owe their origin to cattle of the primest sort imported from England years ago, so that to all intents and purposes the meat that is sent to us in tins is precisely the same as it would be were we to slaughter our own Hereford oxen, and subject them to a similar process, with this difference, that were we to set about "tinning" beef and mutton, we could ill-afford to be as liberal as is our Australian brother as to the parts best fitted for preserving. Just as we, in the ordinary way, eat up the ox or the sheep from his head to his tail, in all probability should we exhibit equal economy in consigning him to the canister. But the Adelaide and Melbourne exporter has discovered that it pays better in the long run to "put up" only the primest and most substantial parts of animals. As for any apprehension that may be felt on the score of cleanliness and the delicate handling of the meat, that is positively assured by the fact that any carelessness in this respect would infallibly recoil on the heads of the delinquents, for the contents of the can would be ruined, and rendered only fit for the tallow-melter and for manure, after all the expense of packing and shipment. The following are among the rules observed in nearly all the Australian preserving factories:—"No animal to be killed in a fevered or excited state after driving; fourteen days at least to elapse from the end of their journey until they are slaughtered. No animal should be slaughtered that has not been previously kept without food for at least eight or ten hours; undigested food, which has only recently become absorbed into the circulation, is very liable to decomposition, and will cause the meat to putrefy. The meat should be allowed to set thoroughly before it is subjected to the preservative process and should be exposed freely to the air while it is setting. Care must be taken that the meat is perfectly good. It must be borne in mind that if fermentation has commenced in however small a degree, before the meat is cured, it will continue. It is absolutely necessary that the atmosphere should be clear while the preserving operations are being carried on. The best parts only of the beast should be cut up. All meats should be cured with a sweet pickle, one-third part sugar and two-thirds salt. All kernels to be taken out of the meat before it is cured, any that may be left in are certain to turn bad."

It would be impossible for the most fastidious to object to any of these rules and regulations as regards the preparation of the meat for the tin can that is to receive it. Nor need anyone feel any uneasiness lest the meat should be roughly handled after it has undergone the cooking process. The fact is, that after it is cooked it is not touched at all. The beef or mutton is placed raw in the tins which are covered in and made quite air-tight, except for a little hole in the top left for the escape of air and steam. After this the tins, as yet unpainted, are placed, closely packed side by side, in a receptacle containing a solution of chloride of calcium, and which reaches about half-way up the tins. In this they are kept boiling for about four hours, and then the small hole that was left in the top of the can is closed with the soldering iron. This, excepting the painting of the tins when they grow cool enough, is, in the majority of cases, the whole process of preserving meat in tins. There are other processes, as, for instance, that which is known as the Aberdeen method, and which differs from that above detailed, inasmuch

as the tins containing the raw meat are hermetically sealed before they are subjected to cooking, and that after boiling some time a hole is "jobbed" in the top with a piercer, and dexterously closed again the instant the accumulated vapour has escaped, and this is repeated two or three times before the cooking is completed. Water is used for boiling in this process. In the other, the only object in using chloride of calcium instead is because of its capability of attaining a higher degree of temperature. After all the experiments that have been tried, that of simple boiling is found to answer better than any other, excepting that it has at present been found impracticable to avoid "over-cooking," to some small extent. Dipping the raw meat in bi-sulphate of lime, sulphurous acid gas, and dilute sulphuric acid have in turns been tried, and though the flesh operated on is undoubtedly protected against putrescence and made to appear in the English market quite fresh and "rosy," as the butchers say, there is invariably clinging about it a chemical flavour that no amount of cooking can rid it of. Some time since it was suggested by a learned professor that the animals to be preserved should be operated on before they were killed—that they should be compelled to inhale carbolic oxide gas, which, in the space of two minutes, would deprive them of all sense and feeling, when they were to be immediately slaughtered and their carcases consigned to a chamber charged full of carbolic oxide of the fumes of charcoal saturated with sulphuric acid. There is no authentic record, however, of this ingenious method having been tried.

There can be no question that the success of any invention for keeping meat sweet and wholesome during its voyage from Australia, without the process of cooking or tinning, would do more to develope the "trade" than anything that has yet been done. This is the opinion of the gentleman through whose ingenuity and energy Australian meat was first consigned wholesale to England, Mr. D. Tallerman, the present manager of the Australian Meat Agency Company, and, moreover, despite the repeated failures of experiments tried in this direction, he expresses himself as quite confident that the feat will presently be accomplished. It will be a bad day for the blue-frocked monopolists of London and other cities when the first ship-load of beef and mutton, perfectly raw and perfectly fresh, arrives in this country. It is computed at the present time there are in Australia alone 40,000,000 sheep and 3,500,000 horned cattle, to say nothing of New Zealand, and the Cape, and New Granada, and the River Plate, and half-a-dozen other places that could contribute at least as many more amongst them. It is well-known with what marvellous rapidity sheep stock increase, so that, let our friends at the other side of the globe slaughter away as fast as they please, there will be little fear of exhausting the supply. There are hundreds of capitalists who would be willing to take the matter in hand as soon as it was shown to be practicable and profitable. Already there are more than *forty* extensive meat-preserving establishments in Australia and New Zealand, and very many of these are able to turn out a hundred tons of marketable food weekly, including many novel and nutritious preparations that the reader possibly never before heard of. It may be interesting to give a list of good things that one London establishment alone, and whose head-quarters are at 113, Cannon Street, are prepared to deliver, in any quantity and at an incredibly low price, to their customers.

Boiled Mutton
Loin Mutton
Seasoned Mutton
Stewed „
Smoked „
Spiced „
Minced „ Collops
Roast „
Hashed „
Haricot „
Mutton Chops
Spiced Mutton Ham, in tins
Boiled Beef, plain
Roast „
Spiced „
Corned „
Seasoned „
Brisket „
Alamode „
Minced „
Stewed „
Beef and Vegetables
Stewed Rump Steak
Spring Lamb
Stewed Kidney
Irish Stew
Rabbit, plain boiled
Curried Rabbit
Rabbit and Onion
Kangaroo Venison
„ Hams
„ Tail Soup
Sheeps' Tongues, plain
„ „ sweet-salted
Ox Tongues, in tins
„ „ in jars
„ „ in pickle
Boiled Fowl
Roast „
Boiled Turkey
Roast „
Roast Duck and Peas
Boiled Chicken
Oxford Sausages
Bologna „
German „
Essence of Beef
Essence of Mutton
Extract of Beef, Liebig's
Extract of Mutton „
Glaze
Soup and Boulli
Ox Palates
Ox Cheek
Sweet Breads
Calf's Head and Bacon
Stewed Veal
Veal Cutlets
Hotch Potch
Brawns
Roast Pork
Sausage Meat
Ox Tail Soup
Jullienne
Kidney „
Vegetable „
Mulligatawny
Vermicelli „
Maccaroni „
Mock Turtle
Mutton Broth
Beef Tea
Pickled Tripe
Tripe and Onion
Solid Essence of Beef
Preserved Mutton, Jones' Patent
Mutton Hams, honey cured
Mutton „ sugar cured
Roll Mutton
Gigot's Mutton
Spiced Round Beef
Beef Hams
Hambro' Beef
Hung Beef
Mess „
Smoked Tongues
Turtle
Dugong Oil
Dugong Bacon
Sheep's Brains
Desiccated Beef, Bancroft's Patent
Desiccated Mutton, Bancroft's Patent
Uncooked Mutton, Manning's Patent

It appears by Messrs. Tallerman's circular and Australian meat trade report, published in the December of last year, that despite the prejudices of the consumer, and many other obstacles and hindrances, that the increase in the importation of meat in sealed tins is very large. The first importation occurred only seven years ago, and the entire quantity was four and a half tons, valued at £321. In 1871 the gradual rise brought up the amount to eleven thousand eight hundred and fifty tons in one year, in 1872 the returns exhibited a total of seventeen thousand five hundred tons of the value of nearly £900,000, and contributed by the various colonies as follows:—Victoria, 141,416; New Zealand, 86,206; New South Wales, 66,778; Queensland, 16,891; South Australia, 10,500. Considering the difficulties to be encountered, it is, perhaps, on the whole satisfactory that as much as seventeen thousand five hundred tons of this wholesome and nutritious food was bought and consumed in a single year by the people of England, but the figures are by no means startling when one considers the enormous quantity of home-killed meat that in the course of a single week finds its way in and out of our metropolitan market alone, and that at famine prices. The primary cheapness, and the undoubtedly excellent quality of the bulk of the meat sent from the various colonies should ensure for it a sale here that is at least ten times greater than at present, but as the report, already quoted discloses, the trade is most aggravatingly restricted and hampered. We are not surprised to hear that "preserved meats have not yet obtained that hold on public taste as to allow holders to regulate prices at their pleasure. At present their consumption is confined entirely to middle-class people, with moderate incomes, and public institutions. The working classes, as a rule, do not use them, and until they do, the meats cannot be said to be fairly introduced as a recognized article of food. . . . Experience has shown that only up to a certain rate will the public purchase preserved meats, and any attempt to artificially raise these rates results in a cessation of the demand."

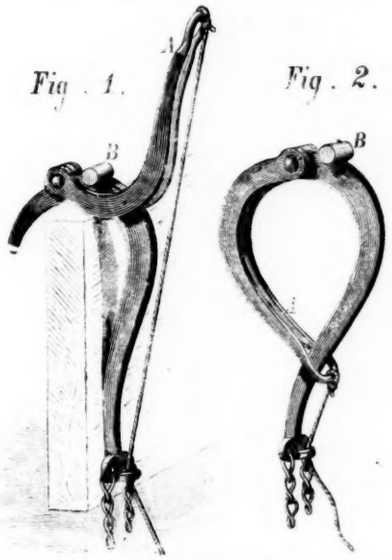
But meat preserved, already cooked and in a shapeless mass, is a very different thing from meat in the joint, and capable of being converted into a roast, or a boil, or a stew at the owners' option. The English working man has a natural antipathy to food the nature of which is not manifest to him at a glance, moreover he likes "something to cut at." His prejudice in this respect is not restricted to Australian prepared viands. Long before Mr. Tallerman's first consignment reached England, there were established in certain districts of London, where the poorer class of French and Germans reside, many cheap restaurants where meats and soups, prepared with a skill far superior to that possessed by the London eating-house or "cook-shop" keeper, were to be obtained at a marvellously cheap rate, but the dishes that are so satisfactory to the working Frenchman gave no delight to the labouring classes of our nation. They despised them as kickshaws and unsubstantial slip-slops, and took their way to the ill-savoured steamy English cook-shop, in the window of which were exhibited the legs and the shoulders, and the mighty ribs of roast, and the luscious hillocks of boiled, though but a miserably small portion of one or the other was doled out to them in form of a sixpenny or eightpenny "plate."

That it is practicable for the Australians to send us fresh beef and mutton in substantial joints, if not in carcases, has been amply demonstrated, but up to this time the process by which the meat is prepared by freezing and otherwise has been found too costly to tempt speculators to attempt it on a large scale. There can be no doubt, however, that the exporters are quite as anxious as the English consumer that the objectionable tin

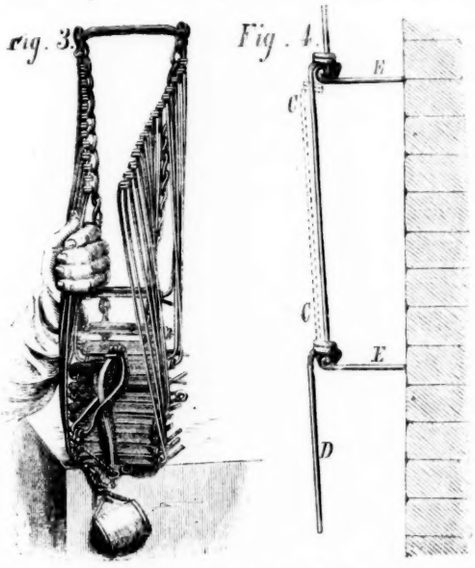
cans should be abolished. The supplying of that necessary vessel constitutes a formidable and utterly profitless item in the colonial meat preservers' outlay of capital. Block tin of the quality and substance required for the purpose is very expensive, as is the labour required to make the articles, and after all, once used, they are not of the slightest value. A tin can large enough to hold four pounds of preserved meat must cost at the least sixpence, which is equal to a tax of three-halfpence a pound on its contents, not very much, it may be said, as compared with the exorbitant price a pound of good beef or mutton fetches at the present time in London, but something very considerable when, as it appears—and the fact is one that must astonish unfortunate Britishers who are accustomed to pay sixteen pence a pound for rump steak—all that is returned to the merchant who provides the first-class meat that is preserved, after shipping expenses and package and agencies are paid, is *three halfpence* a pound. According to the very last issued trade report the demand for Australian meat is still increasing and the present wholesale price for tinned beef and mutton is fivepence a pound for the latter and sixpence for the former. Apprized of this last fact, a grave question presents itself for discussion. How is it that, costing but on an average fivepence-halfpenny a pound, the retailers of London are as a rule charging sevenpence halfpenny and eightpence? Whatever its form while Australian meat preserves its reputation for excellence, it must always command a large sale here, but it must likewise be undoubtedly cheap, otherwise the chief weapon in the hands of its promoters to fight against prejudice is lost. It was the amazing cheapness of the article that was the first importer's most valuable card of introduction. He was able to challenge comparison with the home produced article, and bring forward the favourable evidence of the most famous analysists, and, to crown all, he was in a position to offer the new article, cooked instead of raw, and without bone, at *half* the price of butcher's meat. There seems, however, to be an end to this satisfactory state of things. The grocer and the oilman who has "taken up" tinned meats, instead of being satisfied with a moderate profit on a class of goods that are perfectly safe to deal in, inasmuch as there is no spoiling and no wasting, must need demand twenty-five per cent. for his agency. Acting as middle man for the importers, and incurring no risk and scarcely any trouble, he must have a profit of *twopence* a pound on every can of meat he hands over his counter. Well may importers complain that the principal difficulty they have to encounter is the formidable charges and expenses that at every step of its way, from the factory in Australia to the consumers cupboard, hamper and impede the progress of a meat can. Eightpence for housing and handing to a customer a four pound can of the article is in its way an even more barefaced imposition than for the butcher to charge fifteenpence a pound for mutton chops. It would seem that the grocers, instead of endeavouring to influence the high price of butchers' meat by selling the cheap Australian sort at a reasonable profit, were rather inclined to regulate the tariff of the new by the old article so as not to inflict too much injury on their blue-frocked neighbours. Nothing can be more mischievous to the interests of the important branch of commerce in question than this, and it is evident that the importers themselves are alive to the gravity of the situation, for I have before me an advertisement, issued by one wholesale house, announcing that it has been found necessary to provide shops for the sale exclusively of its own imports, and giving a list of seventy already opened in London alone, at which the public may depend on meeting with fair dealing for any article they may require from a four pound can of beef to a haunch of Kangaroo venison.

BUTTKEREIT'S FIRE-ESCAPE.

THE "Scientific American" reports—Recent ordinances passed in New York city, and also, we believe, in nearly all of the larger cities in the United States, render it obligatory upon owners of hotels, tenement houses, and other buildings in which numbers of people reside, to provide adequate means for escaping from the upper stories, in case of fire. The usual appliance adopted to meet this requirement is a light balcony from which permanent iron ladders extend nearly to the ground. This mode, apart from its expense as a fixture, has the disadvantage of being available only at the point at which it is located, so that if access be cut off thereto, it is virtually useless. This difficulty is overcome in the invention illustrated herewith, which furnishes not only a cheap but a light, portable, and, it is claimed, efficient fire-escape. Figs. 1 and 2 represent the hook by which the ladder used is attached to the building. This device is the subject of a separate patent, and may be employed not only in the above connection but also as a rafter-hook, or, in fact, for any use in which the object is to furnish a secure support or fastening, and also to permit of instantaneous detachment of the same from the sill, rafter, or beam on which it hangs. Fig. 1 shows the hook attached. To it is pivoted, as shown, a



slotted lever, A, which is turned up when the hook is applied to the support. In this position the lever butts against the stop, B. To detach the apparatus it is merely necessary to pull down on the cord connecting with the end of the lever. The latter is thus caused to roll with its rounded inner part on the support, gradually clearing the same of the hook, with which it finally



forms a loop, as in fig. 2. Fig. 3 shows the ladder or fire-escape properly folded in portable form, so as to be carried in the hand; and fig. 4 a portion of the same extended and applied to a wall. The ladder is composed of U-shaped sections made of wire or strap metal, and is so constructed that the side bars of one section embrace and are coiled around the upright side pieces of that next above. The dotted lines, C C, in fig. 4, show the position of the bars of the section, D, when thus raised up. The same engraving also clearly represents the above described method of joining the sections together. It will be seen that, thus constructed, all the sections can slide upon each other, so as to be packed in small compass, as shown in fig. 3. The

rounds of the ladder may, if required, be enlarged by having plates or steps secured to them, the ends of each section being extended laterally from the braces, E E, which keep the ladder at a suitable distance from the wall. Fig. 5 shows the escape

Fig. 5

complete and in actual use, and also exhibits how it may be attached by the hook either directly to the sill or to the inside casing of the window.

For further information address the inventor, Mr. C. G. Buttkereit, Toledo, Tama Co., Iowa.

NAUTICAL NEWS FROM AMERICA.

THE "Nautical Gazette" (New York) opens the new year with a few words from the editor on the "White Star" Line of steamers, which for eighteen months past has been freely criticised, in its management and in its material, by that journal. The subject of the steamer "Adriatic" at present occupies its attention, and it protested against the sailing of that steamer for Liverpool in the end of December with a broken propeller. The "Adriatic" is a large ship, being 437 feet long, with 40 feet 9 inches beam, and 23 feet 4 inches depth of hold; she has four compound engines, with cylinders of 41 and 78 inches in diameter, having a stroke of 60 inches. It is understood that the screw, which had four blades, had two or three of them broken—unequally so. "This is one of the very largest ever built for the passenger trade, and in fair weather her extreme length tests to its utmost capacity her propelling power." She has, notwithstanding, made a quick passage to Queenstown.

In an article on "Wood *versus* Iron-Ships" (January 11), we are told that "It has been taken for granted that both life and property are more secure in steamers than in sailing vessels, against the 'dangers of the seas,' by from one to two per cent. The statistics being resorted to, have shown that the casualties in British iron steamers crossing the Atlantic have reached four and a-half per cent., while those of sailing vessels during the same period have only reached four and a-quarter per cent., and on the lakes the casualties are much greater. Of a fleet of ten iron propellers, a single class of casualties for the year 1872 have reached *ninety per cent.* The owners of some of those iron lake bottoms are endeavouring to make contracts for wooden vessels.

"Not content with checking the advancement of science, and damming up the channels of progress in our merchant marine, these voracious Vulcanites now seek to lay violent hands upon our Navy, which had well-nigh been annihilated during the war, when iron contracts rioted without control.

"Fortunately for the country, the Hon. Secretary of the Navy fixes his binnacle beyond the influence of local attraction, and it were well if the bureau of steam engineering were equally well balanced, both in regard to the utility of iron bottoms and compound engines for the navy, each of which is regarded by practical men as imported humdrums. In giving the reasons for discarding iron bottoms for naval service, the writer will enumerate only the most potent in this connection.

"First, in the *uncertainty of iron* as a foundation, upon which to plant a battery of guns, whether in casemate or turret. Second, the absence of elasticity, a prime necessity in the formation of all moveable structures on land or sea. A railroad must have wooden cross-ties, or it tears itself to pieces. An iron passenger car is discarded because of its want of elasticity. The same is true of vessels. There is a distinction wide as the poles between 'elasticity and flexibility,' which many have thought to be the same. The former is an element of strength, the latter of weakness."

The writer introduces the distinction between elasticity and flexibility, as if that applied as between wood and iron for vessels. Again, he must be aware that there is no analogy between an iron passenger car and an iron ship: the former runs on iron, the latter floats on water. The writer proposes a novel mode of applying armour to ships. "In regard to armour-plating," he says, "it should be put upon the inside of the vessel, where it would be more efficient. Repairs could be more readily made to the hull of the vessel, and the armour would be protected against corrosion. All the windy ebullitions of the iron fraternity in regard to being unable to keep shafts in line in wooden vessels are of no value to practical men, who know how to put iron keelsons in wooden vessels. The keelsons of all vessels should be of iron, as also the clamps and ceiling between decks. They occupy less space when of iron. The iron vessel should be *inside*, and not *outside*, of the wood. England never resorted to iron for ship-building until her forests were gone. Let us emulate her example in this regard. Having but little skill in wood construction, it was her only resource. None better than Englishmen know the dangers of the iron ship. Diplomacy and Duplicity, synonymous terms in England, compel her to keep down the rates of insurance on iron vessels, while she increased them on the wooden vessels of America."

In reply to this latter correspondent, another one writing from Buffalo, insists that "correspondents, when dealing with facts and not ideas, should be careful that the statements they make are true—more especially if they hide their identity under a *nom de plume*." He states that "Every one of the iron propellers on the lakes made their full number of trips, and they are now all laid up in as good condition as they were at the commencement of the season of navigation of 1872. The parties who are most interested in them—the owners—are perfectly satisfied with their performances, and their results; and I will hazard an opinion that the net profits of every one of those iron propellers for the last season was not less than twenty-five per cent. of their entire cost, and that some of them made nearer one-third." . . . "As to the durability of iron propellers, no better illustration can be given at the present time than the iron propeller "Merchant," which is now on the dry dock, for the purpose of being lengthened out *thirty* feet, after a service of eleven years. Her carrying capacity will be largely increased thereby—no additional power being required, and the additional cost of running her will be very little. If the hull had been built of wood, would her owners have considered it a good investment to have lengthened her out, after such a service, or would they have considered it more profitable to have let her run a little longer, then dismantle her, and put her into service as a lumber barge? Most probably the latter!" This correspondent mentions an interesting circumstance that the water in the whole chain of lakes has been receding since 1858. From 1834 to 1858 it gradually rose; since 1858 it has fallen two feet. Should this subsidence of the waters continue the great chain of lakes may eventually become only a river.

"I believe," he continues, "the greatest part of the hue and cry against iron ships on the lakes has arisen from parties interested in dry docks and wooden ship-yards; for they find when an iron ship goes into the dry dock it is only a ghost of a job to repair her. Not like the palmy days of old, when a wooden ship went into the dock, and before she escaped into her native element, the cost of repairs nearly if not quite equalled her value. Many of these parties, like Othello, begin to fear that their occupation is gone."

"Tubal Cain" follows up with a proposal for half and half ships, with iron tops and wooden bottoms. "I learn," he says, "that in Toronto, which is in one of Her Majesty's colonies,

some one has hit upon the very idea I have honestly entertained for a long time, and a propeller is being built of wood in the bottom, as it should be, and of iron in the top, as it would be if I had been listened to in season. . . . . Let us try a new way to win something to our fortunes from iron ship-building. Admit that iron bottoms are not the thing, that wood is the best for bottoms. But wooden topsides rot down and have to be rebuilt; if iron topsides were built upon the wooden bottom, a ship might last for ever. She would have to hammer the rust off occasionally—in fact, the sailors could do this on the voyage, and there would be no expense of docking to overhaul loose rivets, scrape cement, paint, and inspect three or four times a year. There would be no danger of breaking off the hull at any of the compartments, no fear of grounding on stones, or of sharks cracking the plates of the bottom, or of vibration splitting a sheet on the bilge."

"Egg Shell," in the same place, attacks the "cheap iron ships" of England. "If our American builders would secure samples of the English plates, which are so easily cracked and crushed by ice, and subject them to a competitive test with American plates in the presence of the agent of the Italian line now in this country, there is little doubt but that the new ships would be built in the United States. . . . . British ship-builders must not complain about the hardness of Yankee ice. Let them look to the tenderness of their iron plates, and if they cannot make better iron let them keep their ships away from our ports in winter. We have the material to build vessels that will cut through the ice blockades."

The Philadelphia correspondent writes more complimentarily of the White Star Line, and he makes a suggestion which may prove of value in proportioning ocean steamers. "The experience of this line has demonstrated the fact that the hulls of their steamers are remarkably strong, and also that the officers are first-class men and equal to any emergency. Yet, long ships with lean ends are not the craft for winter gales. Owners and builders will ere long heed the suggestions of the British Admiralty, whose records of the performance of sea-going steam vessels, naval and merchant, lead to the conclusion that a first-class ocean steamer should not exceed 325 feet on the load-line, and should have ample beam and a buoyant bow, to keep her head above water." There is evidently a dead set against long, narrow steamers. The editor is "satisfied that the 'terrible storms prevailing in the Western Ocean of late years,' are no worse than before the English began to build those monstrous, long, *narrow* steamers. The trouble is *that this class of steamers make the bad weather*. They are not modelled rightly. If our fishing-boats were built on the same principle they would drown their crews every time the water was *rough*. Some of the fairly-modelled steam craft that are continually crossing the ocean do not report encountering such 'terrific' weather as the long, *narrow* ships do. There is a tendency to blame the weather for a long passage, which may be caused by a foul bottom, an ill-stowed cargo, bad or limited stock of fuel, a broken screw, or other causes, which the owners and captains desire to be kept from the public. It is almost sacrilege to blame the weather for a badly-modelled vessel."

Touching the Bessemer saloon ship the editor informs us that he has "not the slightest faith in the practical working of the Bessemer saloon ship. It is not the rolling motion that produces sea sickness—it is the *pitching*, the descending motion that first starts the victim. Then there is a motion from bow to quarter which makes one feel queer. What is wanted more than anything else to alleviate this terrible malady is ventilation and pure air. We predict that the Bessemer saloon ship will be a failure." In this connection we may notice a rival of the Bessemer ship in the floating cabin devised by M. Alexandrovski, the inventor of the "under water vessel." The construction is very much the same as that of the Bessemer, but the cabin, instead of being attached to a pivot, literally floats in a kind of tank placed amidships between the engines. The invention was tested a few days since by the Grand Duke Constantine, in his capacity as head of the naval department, with a perfectly satisfactory result, all efforts to shake the cabin proving utterly unsuccessful, and the pitching as well as the rolling motion of the vessel being completely counteracted. M. Alexandrovski leaves for England within a few days in order to patent his invention, intending to visit France a little later with the same object.

The results of a test of American chain cable made at the Empire Chain Works, Philadelphia, published in the "Nautical Gazette," are as follows :—

	Lbs.
$\frac{7}{8}$ inch chain broke at strain of . .	15,750
$\frac{15}{16}$ " " " . .	27,000
1 " " " . .	37,500
$1\frac{1}{4}$ " " " . .	100,000

According to Rankine on ship-building, "the ultimate capacity of good cable chain equals 750 lbs. per circular $\frac{1}{8}$ of inch, or 27.3-10 tons per square inch, in form of straight cylindrical bolts." According to this rule—

	Lbs.
$\frac{7}{8}$ inch should break at	12,004
$\frac{15}{16}$ " " "	18,755
1 " " "	26,910
$1\frac{1}{4}$ " " "	75,034

"The chain tested, the data of which we have given, stood an *excess* of strain over the rule figures as follows : $\frac{7}{8}$ in. 3,746 lbs. ; $\frac{15}{16}$ in. 8,245 lbs. ; 1 in. 10,590 lbs. : $1\frac{1}{4}$ in. 24,966 lbs. These samples were from lots made for Mr. Ward, of Detroit, Mich., and were from the same quality and make of iron as this establishment uses in all its work."

A Harrison sectional boiler, consisting of a series of cast-iron hollow globes, exploded at New London, Connecticut. This class of boiler made some little stir in England ten years ago.

It appears that the increasing use of compound cylinder engines in our steam navy, is attracting the attention of the authorities in the States. "One of the marines" writes, that the sole value of the compound engine comes from its adoption in England, and "from a deficiency of knowledge, relating to the plain principles of marine engineering. . . . . Every intelligent engineer, knows very well that steam, at high temperature, is more economical than at low temperature, but the idea of its being more so with a *band-box* end on a cylinder is preposterous. The plain cylinder, with the same length of stroke, pressure of steam, points of cut off, and equivalent proportions, will accomplish the same results with less expense. The *boiler*, and not the cylinder, generates the power. The band-box cylinder offers greater surface for condensation, and 'compounds' all the drawbacks in using steam, but, then, it is *the thing* that takes, but not without strong opposition, in England, where it has superseded engines of lower steam temperature only." The marine appears to forget that cylinders may be jacketed and felted. His patriotic zeal appears to have been roused by the last annual Report of the Bureau of Steam Engineering, in which it is recommended, as the result of a term of inspection in English ships and dockyards, that the compound steam-engine be adopted in the American Navy.

"The information is positive, and there can be no hesitation in recommending that all cruising steamers for the navy hereafter put afloat (well said) be engined on the compound system, and that all the steam machinery stored in the navy yards that cannot be used to advantage in the old vessels, or converted into compound, be disposed of by public sale, or broken up and used as old material." (1871.)

"My last annual report was laid before you just after returning from Europe, where I had been for several months engaged in the examination of the several varieties of steam machinery employed in European naval and commercial vessels." (Newsboy—papers under his arm—hear him re-cry the news first heralded above.) "I then unhesitatingly recommended the adoption of the compound engine for all cruising vessels thereafter constructed. Subsequent information has been received from reliable sources of the success, on trial, of vessels building at the time of my visit, and that the proprietors of the principal steamship lines have ordered all their new vessels to be engined with compound machinery. With such reports and positive information in possession of the Department, you wisely (?) decided that the new vessels ordered to be rebuilt should be supplied with machinery designed on this system, it being of the utmost importance that these vessels should prove a success, to maintain our reputation at home and abroad." (1872.)

Another correspondent, Publicum, feels very sore about it. "The navy is disgraced beyond measure by this errand-running to the dock-yards of the Royal Navy of Great Britain for 'positive information,' and 'subsequent information.' To-day, we are to throw away scores of engines and break them up, because England uses 'compound engines ;' to-morrow, we will have to reject and consign to the scrap heap the present fashionable compound engine, and adopt some other engine in royal favour in the 'old country,' and so on, *ad infinitum*. And wherefore all this copying and imitating, and servile aping of British steam engineering?"

Particularly exercised is he by the insulting language of the Bureau Chief, respecting wooden vessels. "Wooden vessels," says the chief, who, as the Editor says, writes chunks of wisdom, "are not now built in Europe for commercial purposes, and few, if any, will hereafter be built in this country for traffic on the seas—their day has passed." Whereupon, Publicum desires to know, "What business has this passage in a Report of the Bureau of Steam Engineering? The truth is not in it, either as history or prophecy. It only discloses its writer's mind, shallow, unfair, insincere, not to say malevolent and traitorous." . . . "Is it this man at Washington, who is to slime his reports with British bane and virus that shall eat up the last American ship,

as the price of information and naval disgrace." The Editor exclaims in another column, "Heaven spare us the mortifying sight of seeing the naval pennant flying over a tin man-of-war!"

THE IRON AND MINERAL TRADES OF THE NORTH OF ENGLAND, WITH BIOGRAPHICAL SKETCHES AND PORTRAITS OF THE ORIGINATORS AND PROMOTERS OF THESE INDUSTRIES. BY THOMAS FENWICK.

II.—Joseph Pease.

IT was a period remarkable for important transformations in our systems of government and manufactures when Joseph Pease entered into existence.

For many years previous there had been a powerful and pitiless oligarchy in our country, oppressing us with an iron hoof, until public opinion was of no value in influencing our Parliament, whilst our industries were of an insignificant character, until indeed it was apparent that both were either on the eve of a great revolution, which would improve them, or were about to decline and sink into a condition of inactivity unequalled by any other so-called civilized nation.

As, however, there are times in the history of nations in a crisis of this character, when sufficient latent talent is found to avert the threatened danger and rescue a country from disaster, so it was with our own Great Britain.

Our moral power had been weakened, our social power had been degraded, our political power had been withdrawn. Our country, which had an equal opportunity of progressing with other countries, was checked by laws altogether opposed to the dictates of reason and common sense, whilst the inventive faculties of the nation were not exercised. National progress was not practically illustrated.

It is true, great and useful ideas had taken root upon our country's soil, notwithstanding our many imperfections; but the weeds were immensely in excess of the fruit, and far more numerous than all the regenerating schemes which had been brought forward.

At this juncture, however, as already observed, there were raised up men equal to the task—a class of men who were willing to engage in the forlorn hope of rescuing our country from its sad position. Under their guidance a revolution was peacefully accomplished in the minds of men. They were men of high intellectual power, of unblemished character, of stern resolution, and therefore they gained the confidence of the masses, and became the means of imparting national life and vigour.

Simultaneously with this change one of a different character was effected. The nation had begun to think, and this was the secret of its subsequent success. It now produced a race of men whose history is intimately associated with the greatest triumphs of civilization. Watt, Stephenson, and others, whose inventions have conferred blessings upon the whole world, were reared. Joseph Pease was their contemporary. The lights to lighten the Gentiles had appeared.

Strange as it may appear, the ordinary roads and the rivers were the only avenues through which our manufactures could circulate. Railways were unknown. Their influence upon the trading and various other communities of our nation was not experienced. This additional and superior means of communication had not been revealed, civilization had not spread, the barbarians were ignorant of their great utility. The phrase may be liable to objection; it is, nevertheless, true, for it is only fair to regard those persons as such who existed in the pre-railway period compared with our position.

The subject of our sketch was so closely connected with the railway history of this country, that we have considered an introduction of this description desirable.

The family of the Peases can trace their descent from a highly respectable family of this name in the neighbourhood of Wakefield. An old house remains, known as Pease Hall, and the Peases of Hull, bankers, are of the common stock. The Darlington branch of the family from the first became woollen manufacturers. The Peases of Darlington are traceable to one couple, Joseph and Ann Pease, parents of Edward Pease, who were born at Darlington in 1711, and died there November 14, 1785. The Edward Pease, last mentioned, was married in 1735 to Elizabeth Coates, the eldest son of whom was Joseph Pease, of Darlington (born March 25, 1737, married Mary Richardson, Oct. 13, 1763, died April 3, 1808), was the father of the late Edward Pease, and grandfather of Joseph Pease of Southend.

It is evident, from this brief notice, that Joseph Pease enjoyed the advantages of being connected with one of the most respectable, and, at the same time, best-known families in the North. Hence, it is not surprising to be informed that his early education was of a superior kind. It is not difficult to trace his descent, as in the case of some others, who, after having added lustre to their names, and left a legacy to their country, have departed without leaving any record of their origin.

Joseph Pease was born in 1799, and educated under the training of certain members of the Society of Friends. At an early age he was sent to Mr Tatham, of Leeds, whose reputation as a teacher was of a high order. He was subsequently transferred to the care of Mr. Joseph Forster, of Southgate, near London. This gentleman was a strict disciplinarian, an active philanthropist, and possessed of great abilities as a teacher. His nephew survives, and is the Right Honourable William Edward Forster. Under such a tutor, the mind of young Pease expanded, and the great governing principles of his subsequent life secured a sound foundation. He, like the bee, drank the nectar which surrounded him.

But his school-days were over, and he had to be disciplined to the common duties of life. His mind was a vast store, containing pearls of great price, and his treasury was, shortly, to have further additions. His training had been of a character suitable for a mercantile career; but he was also to be acquainted with the process of woollen manufacture, at that time one of the principal industries of Darlington.

The firm under whom Joseph Pease was to be apprenticed consisted of his father, Edward Pease, the founder of the first passenger railway in England, who was born May 31, 1765, and died July 31, 1858, and his uncle, Joseph Pease, who obtained a reputation as the active friend and supporter of Clarkson and Wilberforce in the anti-slavery movement, and as a founder of the Peace Society. Contemporaries inform us that between both partners there was a unity of principle which was at once the essence of success. They were highly distinguished for sound judgment, and excellent moral character, and were methodical in every sense of the word. They were marked by a degree of speculation considerably above the average of those times.

Young Pease had the example of these constantly before him; and although it was beyond doubt that he inherited some of their good qualities, it was also equally certain that he was deficient in others. But what nature had withheld imitation supplied. This artificial process, in course of time, became so like the original, as to render it impossible to distinguish the one from the other.

Whether we notice young Pease in the counting-house, or in the sorting, combing, and dressing, or other departments of the woollen manufactory, it is worthy of remark that he was an early riser and an ardent student. He enjoyed the reputation, an honest one in this instance, of being an excellent workman in the mill, whilst in the office as a junior clerk, at a subsequent period, he was active, attentive, and punctual.

Having been promoted in the office to the position of correspondence clerk, he was brought into a closer connection with the principals. His father would glance over the letters which had just arrived by one of His Majesty's mails, and having ascertained their character, would write a draft reply. This was handed over to young Pease to complete. It had to be again presented to his father for signature; and in the event of it not being equal to the required standard, was returned, with the command to "Try and write it as it ought to be written." Nor was the instruction without good result. It implanted within him a desire to excel.

Meanwhile, the changes in systems and manufactures, mentioned at the outset of this article, had been progressing. They were shortly to be an accomplished fact. Railways were about to be formed.

On the 18th September, 1810, at a meeting of the merchants of the district, held at Stockton-on-Tees, to celebrate the opening of the New Cut in the Tees, at that town, a committee was appointed to report concerning the practicability of having a canal or railway formed for the better conveyance of goods and merchandise between the towns of Stockton-on-Tees and Darlington, twelve miles apart. A public meeting was also held for the same purpose in Darlington, on the 17th January, 1812, and a second committee was appointed. The Darlington committee consisted of Mr. Edward Pease and Mr. Joseph Pease, sen.; and the former with Mr. Jonathan Backhouse, were also members of the Stockton Committee on July 9, 1818.

For six years the subject was under discussion in various forms, for six years they could not decide upon the relative merits of the schemes. Of these, there were several; one was sug-

gested by Mr. Christopher Tennant, for the construction of a canal from the Tees at Stockton to Evenwood, the centre of the colliery district. Mr. Rennie, the afterwards eminent engineer, had submitted an estimate for a canal between the two towns, which would cost £95,600.

It is scarcely likely that the Peases, who were deeply interested in the welfare of the two towns, would stand aloof when measures of so great importance were before the public. Their manufactures were as important as those of any firm in the north, and therefore they gave their attention to the subject.

They would at times freely discuss the railway project, notwithstanding the diversity of opinion between the two brothers. One conversation in particular is recorded. Mr. Edward remarked, "Well, if I show that a road can be made, at a reasonable cost, by which my horse can draw its four or five tons at the rate of nine miles an hour, whilst yours is drawing only one ton along the common highway at three or three and a half miles an hour, I know which Englishmen will have." The reply was equally characteristic. "I tell thee, Edward, thou wilt drive thy horse up to the very neck in mire, before that is done." A response was ready, and was to this effect. "Well, well, Joseph, we had not better return to this subject again in the office, as it interferes with our business." The subject was nevertheless referred to at a future time, and produced satisfactory results.

It may here be mentioned, that shortly after the conversation, Mr. Gott, of Leeds, one of the largest woollen manufacturers at

JOSEPH PEASE.

that time, was a visitor of Mr. Edward Pease. The matter of railway communication between the two towns was explained to him, and his reply was, "You are right, Edward Pease; you are just making a present to the town of Stockton-on-Tees of £30,000, and to Darlington of about £60,000, and they will not refuse the boon."

These figures were supposed to be the difference in the rates for traffic, on the manufactures and other produce in a year. Subsequent calculations show the estimate to be far below the actual difference.

The Peases were now certain that the construction of a railway was preferable to a canal, and without further delay endeavoured to forward their scheme.

In 1821, Parliamentary powers were obtained for the construction of the Stockton and Darlington Railway, from the river Tees at Stockton to Witton Park colliery, with five branches; the first extending to Yarm Old Bridge; the second to the coal depots, at Northgate, Darlington; the third, known as the Black Boy branch, from Brusselton to Coundon Turnpike Gate; the fourth known as the Evenwood branch, from Norlees House to Evenwood Lane; and the fifth (the Stockton branch) from the river Tees terminus before mentioned to the south-west end of Stockton.

Other branches were formed, and Middlesborough was created as a coal port.

But it may be considered necessary to return to young Pease.

In 1819 he had attained his twentieth birthday, and his father had almost attained his object—permission to construct the railway. The measure was, however, defeated, owing to a combination of landowners and others, headed by the Earl of Darlington, afterwards first Duke of Cleveland. Nevertheless the application was renewed, but the death of George III. caused the subject to be in abeyance until 1821. In the meantime young Pease had attained his majority, had arrived at man's estate, and had become a nominal investor in the railway company. After this

period (1833) he was appointed treasurer to the newly-formed company, and the appointment was of a judicious character.

Possessed of a thorough knowledge of finance, and being of energetic habits and a lively temperament, he was enabled to promote the interests of the company. It was his duty to negotiate purchases of land for the proposed line, and to obtain moral and financial support to the undertaking. In those days it was an exceedingly difficult matter to induce capitalists to invest in new schemes. Bankers regarded the scheme with doubt and did not consider themselves justified in advancing money. The cost of the twenty-five miles of rails for a single row was £125,000.

Young Pease, however, had the pleasure of seeing the whole of the capital subscribed. One of the gentlemen connected with the railway was Mr. Francis Mewburn, whose transactions brought him into frequent intercourse with Mr. Pease, and on suggesting that difficulties might arise if some particular policy were pursued, he would receive the reply, "Francis Mewburn, if I had no more courage than thee I should do nothing at all; thou hast the heart of a chicken."

The young treasurer had found a vineyard for his labours. He was engaged to negotiate with the mineral owners along the route of the new line, so as to induce them to bring their traffic over it instead of the road. The difficulty was great, but it was surmounted. Many of the directors saw the necessity of becoming colliery owners, and thus being enabled to increase the railway traffic. They adopted this plan, and as a natural result the railway traffic soon increased.

The abilities of the young treasurer were especially noticeable at the board meetings. The directors required a little "go," as our transatlantic cousins say, and this was in Mr. Pease. He had energy combined with calm judgment, and possessed a well-balanced mind. It is not our intention to give our readers the idea that these qualities were wanting in the numerous gentlemen constituting the board of the Stockton and Darlington Railway at that time. Their deliberations and actions were characterized by an amount of resolution certainly not surpassed by any more recent board of directors. Still, youth sees different to old age, and what progression is to one is almost retrogression to another. His schemes were bold, and his impetuosity was very striking to a stranger, yet beneath the troubled water was a calm, peaceful lake. His plans rested upon a sure foundation, however superficial and hastily conceived they might at first appear.

Under the control of a highly efficient and influential board of management the railway progressed, and the time for the opening had arrived. The following is from the original in the possession of the Railway Company, and will be read with interest :—

"STOCKTON AND DARLINGTON RAILWAY.

"The proprietors of the above concern hereby give notice that their main line of railway, commencing at Witton Park Colliery, in the west of this county, and terminating at Stockton-on-Tees, in the east, with the several branches to Darlington, Yarm, &c., being about 27 miles in extent, will be opened for the general purposes of trade on the 27th inst.

"It is the intention of the proprietors to meet at the permanent steam-engine, erected below the Tower at Brusselton, near West Auckland, and situate about 9 miles west of Darlington, at eight o'clock, a.m., and after inspecting their extensive inclined planes, then proceed at nine o'clock precisely, by way of Darlington and Yarm, to Stockton-upon-Tees, where it is calculated they will arrive about one o'clock.

"An elegant dinner will be provided for the company who may attend, by Mr. Foxton, in the Town Hall, Stockton, at three o'clock, to which the proprietors have resolved to invite the neighbouring nobility and gentry who have taken an interest in this very important undertaking.

"Any gentleman who may intend to be present on the above occasion will oblige the Company by addressing a note to their office, Darlington, as early as possible.

"A superior locomotive travelling engine, on the most improved construction, will be employed, with a train of convenient carriages, for the conveyance of the proprietors and strangers.

"Railway Office, Darlington,
"*Sept.* 14, 1825."

The scheme of the Peases was an accomplished fact, and railways were not only inaugurated, but steam-engines were spreading abroad their civilizing influence. Under the protection of the Peases George Stephenson had been enabled to perfect his newly-discovered power, so that it was practicable to convey passengers and other traffic in a far more expeditious manner than hitherto. Stephenson owed a debt of gratitude to the Peases. Nor did he allow their kindness to sink into oblivion. Many years after his first great successful enterprise, when the name of Stephenson was a household word, he presented Mr. Pease with a gold watch, bearing the inscription—

"Esteem and gratitude.
"From George Stephenson to Edward Pease."

The gift was highly prized, not so much for its money value, as an indication that his efforts were appreciated.

Railways and steam-engines were destined to effect a revolution in our country and the world unequalled in the history of civilization: the words were incorporated in our vocabulary.

It has been a question for discussion at various times whether the Stockton and Darlington Railway or that of the Liverpool and Manchester Company was the first passenger line. It is evident, however, from the following letter, that the former was in operation prior to the other, having been sanctioned by Parliament. The second letter also further corroborates this, and is an interesting chapter in railway history, as an evidence of the conservative views entertained at that period by many persons :—

"To ED. PEASE, Esq., Darlington, Co. Durham.
"Royal Hotel, St. James Street,
"London, 10th March 1825.

"Ed. Pease, Esq.

"DEAR SIR,—I take the liberty to address you on behalf of the Liverpool and Manchester Railway. Our bill is now before Parliament, and we are, of course, anxious to strengthen our case on every side as much as possible. We understand our opponents mean to represent the Darlington Railroad as a complete failure. This differs very much from our own idea of the facts. May we trouble you to transmit us some correct information on the subject; that is, whether the rail is found strong enough to carry the weight which is now moved or intended to be moved upon it, whether the *breakages* are frequent, and whether the rail bends when it does not break. The strength of the rail, I believe, is 28 lbs. per yard. In short, does it answer? and is it likely to continue to answer the purpose for which it has been constructed?

"I was at Darlington last spring with Mr. Ellis and Mr. Sandes, and we certainly carried back with us a very favourable impression of the principle upon which the rail is constructed. Mr. Stephenson also (who is here) has just shown me a letter from Mr. Mewburn, speaking of your road in very favourable terms.

"May I beg the favour of an early reply.—I am, dear Sir, yours most obediently, HY. BOOTH."

To J. PEASE, Esq., Darlington, Durham.

Newcastle-upon-Tyne,
Oct. 19, 1824.

Dear Sir,—Yours of the 16th has been forwarded to me. The remarks that the Rotherham people have made of the liability of the cast-iron breaking, when cast round the wrought-iron, is very erroneous (*sic*); for it is well understood at Newcastle-upon-Tyne not to have that effect, if a certain allowance is made for the bulk of metal forming these junctions. I am well aware that none of these people will give themselves the trouble to erect such a bridge, so long as they have more orders than they can execute, which is the case, I suppose, with every ironmaster in the kingdom, as the price of iron has advanced so much lately, and is still likely to advance higher. On that account, I should advise a stone bridge to be erected, if Mr. Benomi thinks there is no danger of its tumbling down. I think it would be much safer if the abutment walls were allowed to stand over the dead of winter before the arch is commenced with. If a severe winter should come upon the new arch, there might be danger of its settling more in one point than in another. You can have Benomi's opinions on these points. Did not Mr. Longridge send in an offer for the bridge?

I am,
Dear sir,
Yours very truly,
GEO. STEPHENSON.

P.S.—We have sad work with Lord Derby, Lord Sefton, and Bradshaw, the great canal proprietor, whose grounds we go through with the projected railway. Their ground is blockaded on every side to prevent us getting on with the survey. Bradshaw fires guns through the night to prevent the surveyors coming on in the dark. We are to have a grand field-day next week; the Liverpool Railway Company are determined to force a survey through if possible. Lord Sefton says he will have a hundred men against us. The counsel thinks these great men have no right to stop a survey. It is the farmers who have a right to complain, and by charging damages for trespass is all they can do.

G. S.

Of the influence of railways and the steam-engines upon the industries of this country and the world, it is scarcely necessary to dwell. It need not be recorded by our pen how Great Britain was raised from the middle-rate position into which she had fallen; how civilization spread, how communities were closely assimilated, how national thought was re-established after years of mental drowsiness; how, in a word, our manufactures and wealth increased, and the elements of prosperity appeared to an extent unprecedented in the annals of any ancient or modern empire. These are facts indelibly engraven upon the minds of the youth and the aged of our country, and are illuminated in the historic page. Whatever national advantages may have arisen from the introduction of railways and steam-engines, it is clear that the Stockton and Darlington Railway was in operation before that of the Liverpool and Manchester Company, and that it was mainly owing to the enlightened policy of the Peases, supported by Mr. Joseph Pease, the subject of the present sketch, to whom we now purpose returning.

Arrived at manhood, and having indeed enjoyed its advantages and disadvantages, its pleasure and sorrow for some years, in connection with his numerous business engagements, the time was considered opportune for entering into an engagement of a different and perhaps more agreeable nature.

Of the personal appearance of Mr. Pease, we have not touched; nevertheless, he is said to have been strikingly handsome, tall and graceful, modest, yet courageous. A fine manly figure with such qualities, could not be otherwise than an object of admiration with the fair. It has been so in every age of civilization, it was no exception then. Many were the darts hurled at him, but he evaded them with the strategy of a Von Moltke. His thoughts, however, were maturing upon the subject of marriage, and he was desirous of performing his duty to society. Marriage is said to be the meridian of human happiness, and Mr. Pease had almost arrived at this point. In 1826 he married Miss Emma Gurney, daughter of the eminent banker, of Norwich. The ceremony was conducted after the manner of the Society of Friends, and the event was one of interest in his after life. It was the means of bringing him into immediate relationship with a wealthy family, and of giving him a position which was of value in developing the vast resources of the district where his first great enterprise was already firmly established.

At this period the railway to which he had devoted several years of labour was in a flourishing condition, and as the coal export trade at Stockton-on-Tees had recently been developed (the first shipment being on the 26th of January, 1826) it was desirable to increase the facilities of the port. It was believed that 10,000 tons of coal would be shipped from Stockton-on-Tees every year; the figures were not excessive, as the returns subsequently proved. As the coal traffic at Stockton-on-Tees was increasing, Mr. Pease was not slow in observing that an additional outlet was required, and that indeed it was imperative. From his mind emanated the idea of constructing a line of railway between Stockton and Middlesborough. The latter place consisted of a solitary farm-house. It was with the object of developing the coal trade and thereby increasing the revenue of the Stockton and Darlington Railway Company, that, aided by his relatives and friends, Mr. Pease applied for powers in 1827 to construct the new line. The opposition was fierce, yet it was overcome. The towns of Yarm and Stockton opposed it, notwithstanding the beneficial results produced subsequently, but their protests were of no avail, for it must be remembered that Joseph Pease was a powerful leader.

The connecting link of railway was progressing, and he became the founder of a company, and also a large shareholder, to purchase 500 acres of land whereon to establish suitable accommodation for the shipment of coal. It would appear from data before us that his efforts were not confined to one department of trade. He was a partner in the Pottery, also Messrs. Bolckow and Vaughan's iron-works, and those of Messrs. Gilkes, Wilson, and Company. These were erected after the completion of the railway.

Middlesbrough was thus created by the enterprise of Mr. Pease, who, in conjunction with Messrs. T. Richardson, H. Birkbeck, S. Martin, Edward Pease, jun. and F. Gibson, became the proprietors of the Middlesbrough Estate. The others retired, however, in the course of time.

The railway from Stockton-on-Tees to the new town was completed in the year 1830, or nearly five years after the first line of railway, eleven years before the line from York to Darlington, and fourteen years previous to communication being established from Newcastle-on-Tyne to Darlington, also seventeen years before the York and Newcastle-on-Tyne Railway Bills were passed by Parliament.

The opening of the line was under peculiar circumstances. It was in December, 1830, on a day when the cold was more intense than usual. The company was select, and it was evident from their anxiety that they were largely interested in the inauguration. One of the company was especially prominent, and his actions indicated that his interest was of an exceptional character. That was Mr. Pease. There being no public hall or other convenient building wherein to assemble and wish success to the new enterprise, a large gallery was considered best adapted for the historical scene. This gallery was for the purpose of running the coal waggons along to the drops, and it was illuminated with portable gas. It was here the ceremony was performed.

However much our personal opinions may differ concerning the various ceremonial observances which have entered into our national and domestic institutions, there is only one opinion regarding the christening of a child. It is essential for various reasons. On the same ground we maintain that the christening of a town is equally necessary. Therefore whatever statements were made or arguments adduced at the christening of the railway and town of Middlesbrough, we are not prepared to affirm or contradict, but we do maintain that the ceremony was performed with an earnestness worthy of the object.

The Middlesbrough of that day had a population almost *nil;* it had no works of importance, nor gigantic wharves. No dwelling-houses of any large extent, or public institutions, adorned its streets. It was a vast expanse of country, intersected by the majestic river Tees.

The Middlesbrough of to-day is entirely different. It has a population of 50,000, and is increasing at the rate of 5,000 annually. It has an area of several miles covered by ironworks and other industrial establishments, and densely studded with dwelling-houses, with several public institutions erected by those who have attained eminence in the town wherein their wealth has been acquired. It is a shipping port of magnitude, and is possessed of a river superior for its navigation.

The district has also changed. Stockton-on-Tees, Darlington, and the Hartlepools, have been raised from a population of about 5,000 to about 50,000 each, whilst other places have multiplied their population proportionately. These changes are clearly traceable to the surprising development of the iron and mineral trades, aided by the introduction of the railway system, without which the district would have retained its virgin purity, the imperial revenue would not have been immensely improved, and thousands of human beings would have been deprived of the rewards of labour, or would have had to emigrate.

The Peases had all contributed their share in order to make this inroad upon the district. Their manufactures were various and extensive. Under their influence local literature progressed. The first weekly newspaper published in Darlington, the residence of Mr. Pease, was in February, 1849, with the title of the "Darlington Times," and the first daily newspaper was the "Northern Express," published in 1860.

It has been remarked that their manufactures were considerable. So far back as the first Exhibition of 1851, in London, the name of Pease was inseparably connected with that important undertaking. The flags floating from the roofs of the Crystal Palace (probably indicating a supremacy?) were made by Messrs. Pease and Co., whilst the iron of which the immense building was made was smelted by Pease's coke, and geological sections from their iron and coal mines gave instructions to foreign visitors concerning the great Cleveland district of world-wide fame. Their firebricks and cobourgs gained prizes at the Exhibition.

The north of England now included in its list of manufactures a variety unequalled by any other district. It was, however, more especially known for its mineral wealth. The opening out of the railways in various parts had been the means of developing the collieries and ironstone mines along their route, until it was enabled to take high rank with old-established localities.

In these operations Mr. Pease took a prominent part. His active mind would not allow him to quietly stand aloof. On the contrary, he was one of the most active and energetic of those whose names will be handed down to posterity as the originators of a trade which will henceforth be regarded with amazement by the historian, and in comparison with which our previous industrial enterprises sink into comparative insignificance.

Mr. Pease was the medium employed to support Messrs. Bolckow and Vaughan in their gigantic schemes, and it was he who rendered them financial assistance at a time when the commercial communities viewed their proposals with doubt.

The various stages of the development are interesting to review. Each was indicative of clear judgment; each was commenced at the best time.

In 1830 the Adelaide Colliery, near Shildon, was sunk, and its produce was a further means of increasing the traffic of the Stockton and Darlington Railway. About the same time Mr. Pease became a partner in the South Durham Colliery, held

under lease from Lord Eldon. The former is still held, but the latter passed into other hands on the expiration of the lease in 1846.

He and his partners—afterwards known as the firm of Messrs. Joseph Pease and Partners—also purchased the Roddymoor Collieries in the neighbourhood of Crook, which, with the additional tracts of coal royalties leased by them from the late Mr. Charles Lyon, have been developed into the extensive concern now more generally known as Pease's West Collieries. Under this title are usually also included the Stanley and Wooley Collieries, opened out by the same firm in the immediate neighbourhood, and which are well-known in the north of England by their respective names. In 1853, or about this time, a very extensive royalty was leased by them in the Dearness Valley, between Durham and Crook, belonging to Viscount Boyne. Mr. Pease was still for railway progress. He proposed that the North-Eastern Railway Company should open out this new and prosperous district by the construction of the Dearness Valley Railway. The suggestion was favourably received and the line constructed, upon whose route the Esk Collieries have since been opened and successfully worked. A colliery, under the same management, was also opened in the neighbourhood of Tow Law, now known as Hedley Hope Colliery.

As might be anticipated, in a locality where so many collieries were in operation and manufacturing concerns had risen into importance, coke-ovens and fire-brick works would be begun. Several places of this description were commenced, in connection with the collieries just enumerated.

But his attention had hitherto been devoted to the collieries west of Darlington. He now was about to open out the mineral wealth on the east side.

The Cleveland ironstone had been discovered, and the locality was considered a fair field for his enterprise. Success was already attending the efforts of many firms, and he was desirous of participating in the lucrative business of mining.

Mr. Pease ever entertained an idea that, in order to make any mineral property valuable, its means of transit must first be perfected. Therefore he brought his reputation as a successful railway promoter and mine-owner to bear upon the subject of a proposed new line of railway between Middlesbrough and Redcar. Parliamentary power was obtained in 1845, and the railway was opened for traffic in June of the following year. This line was of great value in supplying the iron-works just erected at Eston Junction with ironstone from the Eston Mines.

The Codhill Mines were next leased by Messrs. Joseph Pease and Partners. Here also it was desirable to obtain railway communication. The immediate neighbourhood was rich in minerals, and it therefore did not require extraordinary powers of perception to see that a line would be a financial success. The iron-works, which were increasing on every hand, would absorb the whole of the stone, and thus financially improve the position of the railway company, whilst being of immense benefit to the iron-works' proprietors. This was certain. The line was authorized to be made on June 17, 1852, and was opened for traffic on November 11, 1853. and in this we notice an additional proof of the promptitude which is to be found in the whole of Mr. Pease's proposals. Promptitude was one of his leading characteristics.

The new line from Middlesbrough to Guisborough, opened out one of the richest mineral fields in the Cleveland district, and multiplied the value of Messrs. Pease's newly acquired royalties. Like Alexander Mr. Pease proceeded from conquering to conquer. The western district was under his power, the eastern was being overrun by his legions, not however those who carry ruin with them, but whose mission is "Peace, good-will toward men."

Already a large tract of country had been placed under requisition by his order, already the requirements had been supplied. He now made a claim upon other parts. Various new royalties for the working of the ironstone were obtained, and a short time sufficed to prove their value.

Middlesbrough, in the meantime, was being developed. Its export trade had become of great importance, and the town itself was the centre of the iron trade. The other sister towns—Darlington, Stockton, and the Hartlepools, were growing at an equally rapid rate. They also were important places, and dependent upon the iron trade. The district in general was attaining a degree of eminence unequalled in its history.

Mr. Pease was now largely interested in many departments of trade. He was a railway director, a colliery owner, mine owner, and fire-brick manufacturer. In addition to these, he had acquired an interest in the engine works of Messrs. Robert Stephenson & Co., of Newcastle-upon-Tyne. It should be remembered also that his interest had not ceased in the woollen manufactory at Darlington, his native place, and likewise the scene of his first commercial enterprise.

Yet, numerous and various as were his engagements, he found time to take up the business of pig-iron manufacturer. He acquired an interest in certain new blast furnaces in the Middlesbrough district; and although only a small portion of his time was devoted to these, he nevertheless was always well posted in every matter concerning this department.

In addition to the many branch lines which had been constructed in connection with the Stockton and Darlington Railway, and of which Mr. Pease had taken a leading part in the formation and management, was the Bishop's Auckland and Weardale Railway. It was partially opened on the 30th January, 1843, but was not generally opened for traffic until the 8th of November in the same year, when it was extended to Black Boy and Witton Park. The Weardale and Derwent, and the Weardale Extension railways were constructed in the meantime as private lines. Parliamentary sanction was also obtained for the construction of the Wear Valley Railway between Witton Junction and Frosterley, which was opened August 3, 1847. Mr. Pease became a joint-proprietor of this line, and one of the lessees of the other Weardale branches a few weeks before the opening of the line just mentioned.

These railway extensions opened out a vast field of mineral wealth in South Durham, which added immensely to the mining enterprise of the north. Indeed the whole of the Cleveland district was largely benefited by the railway extension.

It may be thought that owing to the multiplied engagements of Mr. Pease he would not have time to devote to the interests of the Stockton and Darlington Railway Company. The idea is erroneous. Notwithstanding the demand upon his time, he yet found increased opportunity for promoting the interests of the shareholders. His first love he never deserted. Whenever circumstances would allow him, some scheme was suggested whereby the revenue of the company could be increased. He was now a director, and had attended the board meetings with great regularity ever since the formation of the company. No one knew better than Mr. Pease the various stages in the origin and career of the Stockton and Darlington Railway; no one had a greater interest involved in its success; nor had any one done more real good for the promotion of the enterprise. The railway was his favourite theme. He was a perfect master of the question of railway finance, for which his former duties as treasurer of the company had eminently qualified him, and this knowledge became of value to him and the company at a subsequent period. It will be probably remembered by many persons now living that the career of many of our largest and most successful railway companies was marked by much uncertainty and doubt at their commencement. Many had an equal opportunity of progressing, with the one under notice, but they were either reduced to a state of bankruptcy or were unprofitable investments. When railway property in every part of the country was seized by a panic, and "bears" were actively employed, the Stockton and Darlington Railway enjoyed comparative rest under the directing power of Mr. Pease; and in this fact we have a further proof of his thorough knowledge of railway finance, and likewise an idea of his sagacity. To him it was clear that the opportunity would not be missed by unprincipled speculators to take advantage of the disturbed condition of railway property in order to undervalue that of the railway under his partial management. He was, however, fully prepared for the emergency.

Mr. Pease has been described as the "life and soul" of the company, and by data before us the term is not misapplied. His actions and general policy have been of an unusual description, and he evidently showed by these that he lived very considerably in advance of the times. The Stockton and Darlington Railway Company are indebted to him for the suggestion of purchasing all the branch lines in the Cleveland district, also to the west of Darlington. His insight indicated to him that these might be made powerful auxiliaries to the parent company. The idea was acted upon, and the branch lines or connecting links were constituted a system, which is unequalled for prosperity by any other company in Great Britain.

The same policy has been pursued for the last twenty years by the directors of this company until the whole of the North of England is under their management. Other companies are only now adopting the plan.

Mr. Pease had lived to see railways firmly established. He was the founder of a system of railways which is like a network running through the entire length and breadth of Great Britain, and which is extending itself to every part of the world. In Great Britain alone the capital invested in railways is estimated at not short of £500,000,000.

He had laboured assiduously for many years in business, and was desirous of entering Parliament, in order that he might confer additional benefits upon his countrymen, by endeavouring to remove many of the laws which for centuries had been a

barrier to progress. These were alike unjust and ungenerous. They were unfit for barbarians, much less for a civilized nation. For many years there had been an intense desire on the part of the people of this country to be emancipated, but sufficient courage was not found within them to make the effort. The government of this country did not represent the masses, but consisted principally of large land-owners, from whom any good measure for the promotion of our manufactures could scarcely be expected. Yet the country was beginning to be more dependent upon the latter than the produce of its soil. In a word, there was Liberty for the rich and oppression for the poor.

Nor was our foreign policy conducive to the dissemination of civilizing influences, for Great Britain had yet to release her thousands of slaves.

Joseph Pease was a member of the Society of Friends, as elsewhere is indicated. He was deeply imbued with their principles, and was exceedingly anxious to improve the social, moral, and political position of the various communities. So early as the year 1820, when Cobbett lectured at Darlington, young Pease listened with profound respect to the great reformer. It is also stated that he was an attentive auditor of Mr. James Silk Buckingham, when he delivered a course of lectures at Darlington on "English Misrule in India."

Under teachers so eminent, and in addition to his political knowledge acquired at school and in private study, it is beyond doubt that Mr. Pease was acquainted with the aspect of political affairs. In 1821, at the celebration of the return to Parliament of one of the first reformers—John George Lambton—the subject of our sketch was present, and the county of Durham was only represented by the gentleman named. By the Reform Bill of 1832, however, South Durham was enabled to return two members. The entire population of the Southern Division was put down at 78,506, or little more than the Hartlepools and Darlington combined at the present day. The number of electors on the register was only 4,336. There are now three parliamentary boroughs within the division, each of which has an equally numerous constituency.

It was decided that Mr. Pease would contest the division, and he did so with ardour and goodwill. A powerful opposition was arrayed against him; and his first address may be of interest as an indication of some of his political views. It was as under:—

"It is with great satisfaction I learn that the sincere avowal of my sentiments, my conscientious abstinence from all acrimonious or party feelings, have secured to me the general confidence. Prejudices have been dispelled, misrepresentations compounded, and the conviction has been implanted, that my aim is to secure the prosperity and to advance the best interests of every order and class of the community. . . . Soon little more will be in my power; the cause will be in your hands. In no point of view can I agree, but especially through a demoralizing pecuniary expenditure, to purchase a seat in the House of Commons. I will never buy what I will never sell. I will never seek to obtain by unworthy means what I have pledged myself to use worthily. If my sentiments be your sentiments—if I am the man of your choice—it is well; with the blessing of Heaven I will do my duty as a man and a Christian."

His address was the cry of the Reformers. Meanwhile, his own candidature was proceeding. The opposition was powerful, and was increasing, yet Mr. Pease believed his return certain. The election took place in December, 1832, and the result was as anticipated, the "Railway Proprietor" being at the head of the poll. He entered the House of Commons on the 8th February, 1833, and declined to take the usual oath; but on the report of a committee, this difficulty was overcome. It is worthy of notice that Mr. Pease was the first Quaker member of Parliament. He positively declined to uncover his head even in the presence of the Speaker. Before a fortnight had elapsed he had been heard within the walls of St. Stephen; before a session had passed, it was remarked by many of the members that the "new member" was diligent in his duties, and punctual in attendance. He voted in favour of the Reformed Government in the principal measures brought forward during their short term of office, and it may here be observed that his maiden speech was in support of Mr. Joseph Hume's proposal to abolish private rights in lighthouses. This was followed by one against a criminal return, in which were words invidiously distinguishing Roman Catholics from Protestants. The amelioration of the laws inflicting capital punishment, a proposed inquiry into the causes of public distress, a condemnation of the brick duty, as discouraging to trade and adverse to the comforts of the people, and another for the strict supervision of savings' banks, were all the subjects of early speeches. He proposed the insertion of a clause in the Metropolitan Police Bill, prohibiting the then popular pastimes of bear and bull-baiting. The clause was lost by four, but the point was gained shortly afterwards. The proposal for compensating West Indian planters until the great measure of abolition was carried into effect, was opposed by him; also the taxing of Hindoos to make them Christians. On the dissolution of the Reformed Parliament, his address was marked with great vigour, showing his pleasure at the abolition of slavery.

It was to this effect:—

"The legislature, of which, through your favour, I was a member, may have failed to fulfil all those sanguine expectations which we together shared when anticipating the easy, and in my humble opinion, still certain, fruits of a real representation of our country. But are we thence to conclude that the extraordinary exertions, the great sacrifices made to obtain the Reform Act, and when the elections arrived to secure its benefits, were made in vain? that those who then professed themselves friends of Liberal measures—reform, economy, and peace—have deluded you, or become either treacherous advisers of the crown, or deceivers of the people? I beg you will pause ere you give credit to such insinuations. Still more earnestly do I entreat you to reject with indignation the calumny which would lead you to suppose that the late House of Commons was deficient in loyalty to the throne, averse to the interests of true religion, or disposed to hazard the blessings which we all enjoy under our present admirable constitution.

"For my own part, as long as I live, I shall cherish the pleasing recollection of what has been effected during the short period I have held the honourable post of representative of a distinguished county; of having been one of those who assisted in striking off the galling and ignominious fetters of slavery from 80,000 of our fellow-creatures, thus rescuing from oppression generations yet unborn, who gave to 100,000,000 of our fellow-subjects in the East, a great charter of British rights; who released commerce from its trammels throughout the remotest bounds of the Indian Empire; who bestowed on Scotland invaluable municipal privileges; who put an end to church rates in Ireland, and were pledged to redress her wrongs; who voted the means of giving education to 100,000 poor children; who restored to the Christian missionary the chapels demolished by turbulence and intolerance; who amended our laws; who diminished the number of capital punishments; who improved our jurisprudence; who laboured to abolish flogging and impressment; who released British seamen from unjust imposts; who swept away thousands of sinecures and useless offices; who, in times of great excitement and difficulty, maintained peace abroad, and laboured to promote prosperity at home; in fine, who lessened our burthens of taxation, and reduced our national expenses yearly many millions, and, notwithstanding all these deductions, left a revenue on the last quarter alone exceeding the expenditure by nearly £1,000,000."

Sufficient information has been given in the foregoing to prove how thoroughly in earnest Mr. Pease was in political matters having for their object the advancement and improvement of the masses. Shortly after the last address was issued he retired into private life.

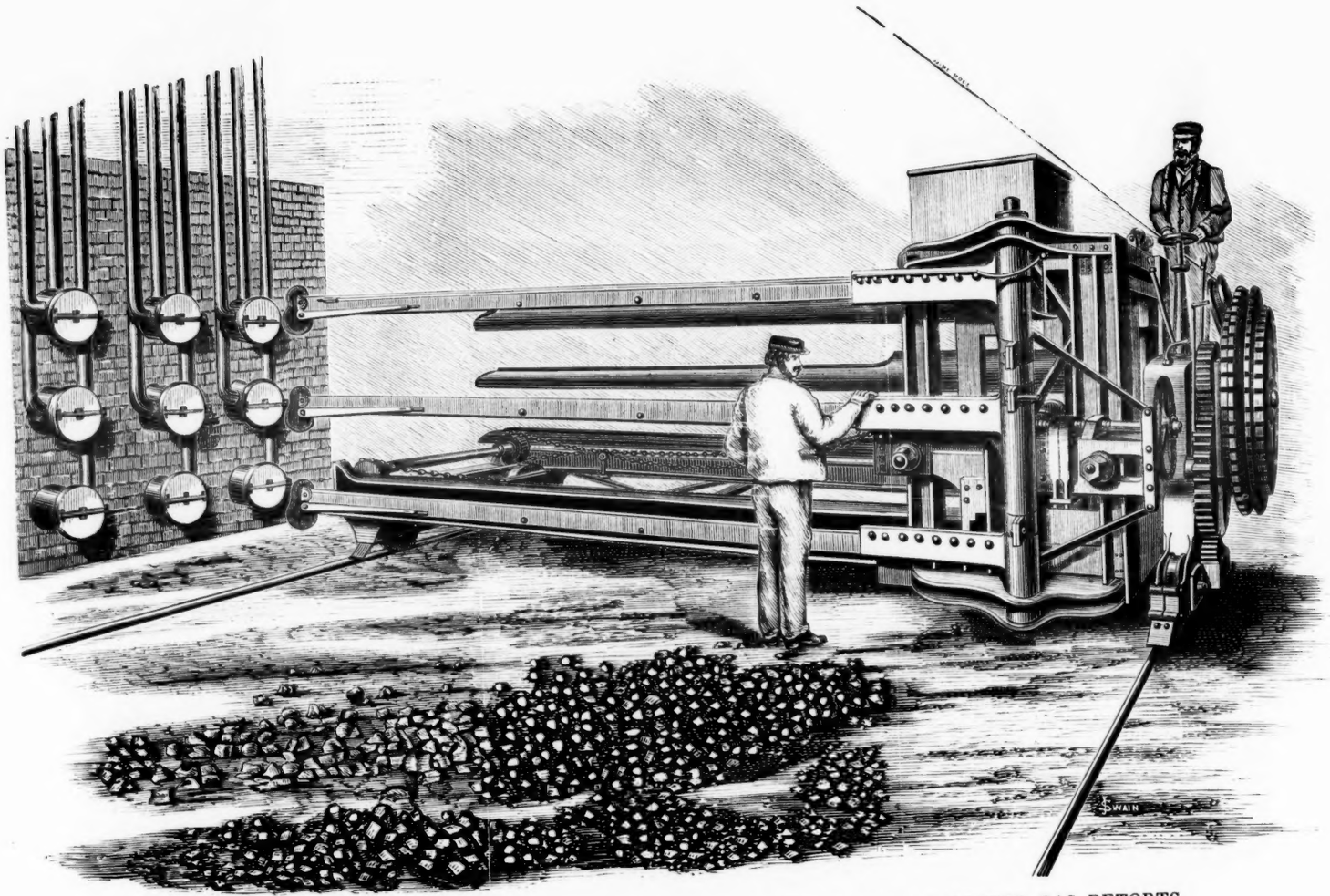
He had ever taken a lively interest in the education movement, and had erected numerous schools on his estates and in his native town of Darlington. A favourite work, "The Principles of Morality," by Jonathan Dymond, was translated into the Spanish language at his expense and freely circulated in Spain; and it appears the Government of that country conferred upon him the Grand Cross of Charles III. as a mark of their high regard for his gift.

It is only fair to mention that, for many of the facts contained herein we are indebted to a notice of the subject of this sketch published in the "Northern Echo" some time ago.

We have reviewed the leading features in a life which is an example of what energy and enterprise can accomplish, and have illustrated it in the various stages, and have shown the secret of success. Mr. Pease died at Southend, Darlington, on the 8th February, 1872, in the 73rd year of his age.

APPARATUS FOR CHARGING AND DISCHARGING GAS RETORTS.

SO much was heard a short time ago about the strike among the gas stokers, that we hail the appearance of the machine—lately erected at the Beckton Gas Works—with pleasure, and expect it will prove a great success. The apparatus which we illustrate was designed by Mr. Holden, of Mark Lane, and, we hear, has been successfully working for some length of time. It embodies much that is important in the way



THE NEW STEAM STOKER, OR "IRON MAN," FOR CHARGING AND DISCHARGING GAS RETORTS.

of improvements upon others that have been constructed. Part of the principle is, that it is worked by a fly-rope, as shown in our illustration, the propelling engine being fixed at the end of the retort-house.

We give first a view of ordinary retorts, with their rising pipes, leading to the ordinary hydraulic main. Upon the working-floor, or stage, is fixed a pair of rails, running the whole length of the retort-house. Upon these, the "traveller" with the carrier run or travel. These consist of the traversing frame or "traveller," and of a superimposed travelling frame carriage, on which the charging and discharging tools are mounted. This latter runs on the traveller with a to-and-fro motion, in a direction transverse to the direction of motion of the "traveller."

In the house is an ordinary stationary steam-engine, which transmits motion to an intermediate pulley, communicating motion to the machine by an endless wire rope, passing round a driving-pulley on the "traveller," and then round another pulley (Fowler's patent) to the end of the retort-house. Thus the whole apparatus can be brought opposite any desired set of retorts.

Our illustration gives a view from the rake side, showing in the distance the scoops or shoots. The attendant stands upon an elevated position, from which he can work the several handles, both for starting, reversing, and withdrawing ; and the same rope which propels the whole machine, acts, with the application of bevel wheels and clutches, to move the carrier in a transverse direction.

When placed opposite the set of retorts to be cleared, the tips of the rakes are first extended by means of motion rods not seen in the engraving, and the whole of the top frame moves forward into the three tubes. When at its extremity, the motion rods are slightly withdrawn, whereupon the tips of the rakes fall, as in the engraving. A clutch is then put in motion, and the carrier hauls back the rakes, bringing with them all the coke left in each retort. At present, during this operation several men fill the shoots with coal, and each set is ready to enter with its charge of coal whenever the retorts are cleared. Whilst one set (either rakes or scoops) are doing their work, the other set, being fixed upon a strong spindle, are turned so as to swing in a right-angled position. When the scoops are in position, and ready for charging, the carrier is again set forward, and when fully in, the scoops are reversed or upset—that is, so turned on their arms as to bring their openings downwards, and they thus drop their charges of coal into the retorts.

When this is done, the scoops are turned on their arms to their previous position (or position in which their openings are upward). The carrier is then drawn back on the traveller, so that the scoops clear the retorts, the mouths of which are then closed, and the manufacture of gas is proceeded with.

During this operation, the rakes are swung out of the way, clear of the retorts, and this operation is carried on alternately, the work being done in one-fifth less time than by manual labour, and with far less danger and exposure to heat to the men engaged.

ABSTRACTS OF PAPERS IN THE MAGAZINES OF THE ASSOCIATED ENGINEERS, ARCHITECTS, AND BUILDERS OF GERMANY.

Magazine of the Association of German Engineers, 1872. *Vol. XVI. Parts 5 to 7 (Conclusion).*

HASENCLEVER. English Iron Mining, &c. Works compared with those of the Continent.—Conditions of transport, prices of coal and climate, as a rule, are more favourable to the former. For the manufacture of soda, for instance, England can draw its iron pyrites from Norway and Portugal, whilst it would be too expensive for Germany to go to foreign countries for it. Salt may be had in Lancashire at 8 gr. per 100 kilogr. ; in Westphalia it costs from 18 to 20 gr. Coal of the size of nuts or walnuts costs 3 to 4 gr. per 100 kilogr. The higher wages paid in England are balanced by the almost double quantity of work performed by an English workman. Favourable conditions of transport admit of the establishment of large and inexpensive factories ; the greater division of labour, the concentration of certain branches of manufacture on particular spots, and the large capital at command, are also great levers of English industry.

Ludwig. On Riveting.—Treatise on riveting, with tables of results of various kinds of riveting.

Gun-cotton.—According to the experiments of Bleekrode, gun-cotton is not rendered more easily explosive by moistening with inflammable fluids, such as ether, benzine, alcohol, sulphurate of carbon, but appears in the burning fluid like a slowly melting snowball.

Hasenclever. Prevention of Pan-scales by Blowing Off.—Experiments made at the Waldmeister works gave no satisfactory results, though after six weeks' working the water in the boiler was not yet saturated with gypsum, there was yet a deposit of 0·6 millimetres in thickness on the dead-plate of the furnace.

Herrmann. Turbines for Tilt-Hammers.—A vertical turbine used in place of a small over-shot wheel produced more speedy revolution, and a saving of 50 per cent. of water.

Leroy's Material for Covering Pipes has yielded the most favourable results in the works of Borsig, since the steam-pipes, twelve hours after the removal of the fire from under the boiler, still contained steam.

Sommer. On Sifting (separating) Coal.—For separators, with V or T shaped rod, the most suitable angle of inclination, according to the experiments made in Upper Silesia, with large coal 26 to 28°, with cobbles 30 to 33°, with nut coal 35 to 36°, and with small coal 40 to 45°.

General Building Gazette. XXXVII., 1872. *Parts 4 to 6.*

Bomches. Quarries of Sistiana.—Supplemental remarks to those reproduced in our first number, page 51. There is a full report of the great blastings from July, 1868, to March, 1872, whence it appears that 8·7 per cent. of the mines had no effect ; 15·2 per cent. threw down only 0·3 to 1 cubic meter ; as many, 1 to 2; as many, above 3 ; 45·7 per cent. 2·1 to 3 cubic meters. Charges of more than 10,000 kilogrs. of powder, and more than one chamber seem to be less effective than smaller charges.

Beger and Binder. Bed of the Rhine in Switzerland.—This detailed account of the devastations of the valley of the Rhine from Thusis to the Lake of Constance, and the measures to be taken to prevent them is not of local interest only, but considers many questions important in mountainous regions. The restoration of the forests that have been cut down is, of course, one of the main conditions, but as this requires many years, means are indicated by which the evils may be arrested or mitigated at once.

Hatzel. On Architectural Forms of Construction.—An attempt to define the forms of construction to be given to consoles, brackets, pillars, and arches, in order to express their static effects. Constructions in iron are only treated incidentally.

Schindler. On Railway Brakes.—Le Chatelier's brake, which acts by introducing water from the boiler into the steam-chest in order to stop the steam piston, seems best calculated quickly to arrest a train, though it has the defect of being applicable to locomotives only, and causing a great loss of heat. Schindler has, therefore, contrived a brake, which is indeed attached to the locomotive, but whose action can be extended to all the wheels of the train. This brake is worked by hand, and the communication of the brake-power to the carriages ensues by the accumulation of speed in the carriages, which as yet go at a greater speed than the already slowed engine, which presses the brakes against their wheels. The apparatus is so arranged that even after the shock the brakes remain tight, though they can be released again without additional hands.

Magazine of the Society of Austrian Engineers and Architects. XXIV., 1872. *Parts 10 to 12.*

Wex. On rendering the Danube Navigable at the Iron Gate, and the Seven Rock Bridges above Orsova.—Though the Danube is the largest waterway in Europe, and its direction is most favourable to commerce, since it connects the productive East with the industrial West, the navigation of this river is as yet but imperfectly developed, the reason of which is to be found in its natural features. In its upper part, from Ulm to Passau it flows through the table-land of Bavaria ; from Passau to Presburg it has to break through eighteen (German) miles of mountains ; then in the great Hungarian plain between Presburg and Bazios it loses much of its

velocity, though it here receives several large rivers, so that it becomes a better waterway than the Rhine and Elbe ; then it has to force its way through a mountain chain—that of the southern Carpathians, and finally in its lowest part traverses, in a length of 120 (German) miles, the great Wallachian plain, until it flows into the Black Sea. The writer of the article suggests that a company should undertake the regulation of the stream between Besburg and Gönyö, by which more than 10,000 acres of waste land might be rendered fit for cultivation, and that the freights should be lowered from 60 to 70 per cent. The removal of the obstacles to navigation between Bazios and Sibb, where the width of the river varies from 500 to 85 yards, and its depth from a few feet to 170 feet, is an affair of the state. The suggestions made by the writer appear very practicable.

Weslinghouse's Air Brake.—Account of this brake tried on the Caledonian Railway.

Winkler. On the Augarten Bridge at Vienna on the System of Five and Lille.—This system of suspension bridges requires 34 per cent. more material than other systems.

V. Haanen. On the application of Beton for House-building.—In England and France, where Portland cement is used for beton, 10 to 12 parts of sand and stone are allowed, whilst in the district of Salzburg, where hydraulic lime is used, only four parts could be added. The walls are built up between wooden, or better, sheet iron plates, the material being allowed twenty-four hours for hardening. Houses of five stories have been erected in this manner, the wall of the uppermost floor being only 24 centim. thick. Such walls are more compact and solid than brick walls, contract but little, dry quickly, and are affected neither by wet nor frost. At Salzburg, where they use Lenbe's cement and four parts river ballast, the cost of mixing and filling in was $1\frac{1}{6}$ thaler the cubic meter ; the cubic meter of finished wall, with the scaffolding for the forms, came to 4·4 thalers, whilst in brick it would have cost 70 per cent. more.

The Bridge across the Danube on the Austrian North-Western Line.—This bridge, 782·5 meters long, has four openings, each 79·8 meters wide, and an inundation bridge with 14 openings, 29·65 meters wide. Its height above the mean level is 10 meters, the height of the inundation bridge above the regulated level of the ground 5·2 meters. On the right bank, not yet levelled, there is a wooden bridge, 103 meters long. The foundations of all the piers were laid in the pneumatic manner by means of caissons ; the erection of a pier on the average took 153 days. The report gives full technical details.

Rikli. Electro-magnetic Distance Signal.—This apparatus dispenses with the clock-work required in Hohenegger's distance signal, for its working 20 elements of Daniell, 2 magnets of 20 kilogr. sustaining power and a pendulum of 120 kilogr. in weight, are sufficient. Its cost is 400 florins. The arrangement would be still more simple if, instead of the signals now in use, others might be substituted, viz., two full disks for "stop" and one full disk for "line clear" ; then 6 elements of Leclanché would be enough.

Law on Railway Signals in Austria and Hungary, which came into force on the 1st of Oct., 1872.

Pollitzer.—Brief description of the bridge across the Bukowina Valley on the Brünn-Vienna railway.

Scholl. Determination of the Constants of Angular Equation of Stampfer's Levelling Instrument.—Detailed and instructive inquiries into this subject.

Steam-boiler Examination and Insurance Company at Vienna.—Such a society, on the mutual principle, has lately been established at Vienna. Its designation sufficiently indicates its scope. Its inspectors will have state authorization for performing their duties in private establishments.

Architectural Magazine. XXII., 1872. *Parts* 8 *to* 10.

Table issued by the Prussian Ministry of Commerce, Industry and Public Works, of the quantities of material to be used in governmental buildings.

Sustaining Power of Building Ground.—According to experiments made at Lübecke it was found that blocks of stone, when weighted to the extent of 1·75 kilogr. per square centimetre, sank in clay 2·99 and in sand 2·94 centimetres.

Heinzerling. Analytic-graphic construction of Arches of Bridges.—We can only refer our readers to this treatise, which is as yet incomplete, but deserves attentive study.

Kaselowsky. Uniform Locomotives.—It may well be asserted that of the 98 German railway lines already existing in 1869, each has a particular pattern for express, passenger and goods' trains locomotives, though it is equally clear that one or two patterns might do for all. That such a simplification would be advantageous for railway companies, manufacturers, and the public cannot be denied, considering that the preliminary labours for a new kind of locomotive cost from 2,000 to 3,000 thalers. The author gives additional reasons for aiming at, and suggestions for carrying out, such uniformity.

Chemistry applied to the Arts, Metallurgy, Chemical Manufactures, and Allied Subjects.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF CHEMICAL SOCIETIES, &c.

§ 1.—*Acids, Alkalies, and Salts.*

FABRICATION of Fuming Sulphuric Acid.—JAHN states that the roasted green vitriol employed in the manufacture of Nordhausen sulphuric acid is not, as usually supposed, chiefly *ferrous* sulphate, but contains most of the iron in the *ferric* state ; hence the loss from formation of sulphur dioxide is not great, the yield of acid varying from 42 to 53 per cent. of the "vitriol stone" used, a quantity much greater than that which would be obtained from ferrous sulphate. *Polytechnisches Centralblatt*, 1872, 751.

Preparation of Nitrous Acid.—STREIFF adds water to the so-called lead chamber crystals, prepared by passing dry sulphur dioxide into well cooled nitric acid ; the gas evolved by the action of water on the product is said to be nitrous acid. *Berichte der Deut. Chem. Ges. v.* 285.

Manufacture of Tartaric Acid.—KURTZ describes the methods of preparing and purifying tartaric acid from crude tartar, wine yeast, and the residues from the seignette-salt manufacture and the refining of cream of tartar. The crude tartar is dissolved in water, heated nearly to boiling by the injection of steam, and neutralized by chalk, whereby calcium tartrate is precipitated, and soluble potassium tartrate produced ; crude tartars rarely containing more than 80 per cent. of pure acid potassium tartrate, less than the theoretical quantity of chalk (1 part to 3·76 of tartar) is requisite according to the purity of the tartar employed. When much colouring matter, magnesium and iron oxides, or alumina is present, it is as well not to neutralize completely, and even to add a little hydrochloric acid to retain these substances in solution. The nearly neutral solution of potassium tartrate thus obtained is treated with gypsum (derived usually from other portions of products obtained in the extraction of tartaric acid) ; after several hours the re-action is completed, calcium tartrate being precipitated, and nearly neutral potassium sulphate remaining in solution ; the addition of the gypsum may take place in the same vessel as that employed in the chalk neutralization process, and may even precede the addition of the chalk ; the quantity of gypsum depends on the chalk used, 1 part of the latter corresponding to 1·72 of the former.

The contents of the vat in which these operations have been conducted are then allowed to settle and to cool to about 50° C. ; the supernatant liquors are run off by a syphon, and the calcium tartrate precipitate is washed three times by decantation, and then decomposed by sulphuric acid ; complete washing out of the potassium sulphate solution is essential, otherwise the crystallization of the tartaric acid finally obtained is much impeded. Sufficient water is added to make the mass of tartrate and sulphuric acid into a tolerably fluid magma, the acid being added little by little until somewhat more than the quantity theoretically requisite (4·9 parts of acid for 9·4 of calcium tartrate) has been employed, the excess of acid facilitating the subsequent crystallization of the tartaric acid ; the mass is then strained into leaden pans and evaporated by means of steam pipes, the temperature not being allowed to rise above 70° to 75° C. in concentrated solutions, to avoid blackening from the action of the excess of sulphuric acid ; when the solution reaches 40° Beaumé, it is run off into crystallizing pans, the crystals formed being smaller, the quicker the crystallization takes place ; the mother liquors are run off and evaporated separately, and allowed to crystallize three times in succession, the last mother liquors being employed as raw material, being too impure for the direct ex-

traction of tartaric acid. The crystals are dried in a centrifugal machine, dissolved in water, decolourized with "spodium," and allowed to crystallize again after filtration, acidulation with sulphuric acid, and evaporation to 35° or 40° Beaumé. The crystals thus obtained are fit for the market; they contain small quantities of sulphuric acid and of lead, and for pharmaceutical use are again recrystallized in earthenware pans, without the addition of sulphuric acid.

The extraction of tartaric acid from wine yeast is performed in the same way, the yeast containing from 7 to 20 per cent. of tartrates when freed from liquors by pressure; these liquors are converted into brandy known as "Lagerbranntwein," possessed of a powerful odour and taste, owing to the presence of large quantities of alcohols and compound ethers, other than those of the ethyl, or ordinary alcohol series. The residues left on distillation of the brandy, and the pressed yeast, are treated by dissolving in water acidulated with hydrochloric acid, and heated nearly to boiling; after settling for some hours, the liquors are run off and neutralized with chalk, whereby calcium tartrate is thrown down; this is then treated as above. *Dingler's Polytech. Journal, cciii.* 123.

Production of Pyrolignic Acid.– TH. SCHWARTZ finds that this acid may be obtained by a more simple method than that which is usually followed. The wood to be distilled is first freed from its water by gentle heating to a temperature not exceeding 120° C. It is then exposed to a temperature gradually rising to about 240° C., when a concentrated acid, almost free from any tar, will distill over. The wood in this operation is not destroyed, but becomes hard and dense, and is applicable for all those purposes for which ordinary wood could be employed.

The chief advantages of this method lie, however, in there being no need of converting the products of distillation into lime acetate in order to separate the pyrolignic acid from the tarry matters. *Monit. Prod. Chim.* 10 *Dec.* 1872.

Preparation of Propionic Acid.—FREUND acts on lactic acid (60 parts) with hydriodic acid, obtained by the action of sulphuretted hydrogen on iodine (60 parts suspended in 140 of water); the product is distilled until 100 parts have passed over. Sulphuretted hydrogen is passed through the residue, and the liquid distilled again after several hours' digestion with an inverted condenser attached; about 62 per cent. of pure sodium propionate is obtainable. *J. Prakt, Chem.* [2] *v.* 446.

Chlorine Manufacture.—TESSIE DU MOTHAY prepares chlorine by passing hydrochloric acid over manganese peroxide, or a mixture of manganese peroxide and lime, contained in retorts at a dull red heat; water vapour and chlorine are thus produced, the latter being used for making bleaching powder, &c. A stream of atmospheric air is then passed over the mass left in the retort, whereby chlorine is again evolved from the manganese and calcium chlorides present; this diluted chlorine is absorbed in stoneware jars containing a mixture of lime and manganese oxide (produced by adding excess of lime to manganese chloride); a mixture of calcium chloride and hypochlorite with manganese peroxide is thus produced, from which pure chlorine is evolved by the addition of liquid hydrochloric acid; there is then left in the vessel a mixed solution of calcium chloride and manganese chloride, from which excess of lime throws down manganese oxide ready for use over again, the supernatant calcium chloride solution being syphoned off, and treated with magnesium carbonate; calcium carbonate is thus formed and magnesium chloride, which latter yields, on heating, hydrochloric acid capable of being used for the generation of chlorine as before; whilst the mixture of calcium carbonate and magnesia left can be used again to decompose calcium chloride, carbonic acid being also led into the mixture, so as to form magnesium carbonate. *Chronique de l'Industrie*, 1872, 178.

Preparation of Potash and Soda from their Sulphates.—TESSIE DE MOTHAY treats the sulphates of potassium or sodium with water and quick lime, in an apparatus cooled down to 0° to —20° C. for twelve hours; from 75 to 80 per cent. of the sulphate is then converted into caustic alkali; the residual sulphate can be removed either by the addition of baryta, or by crystallizing it out.—*Bericht. der Deut. Chem. Ges. v.* 741.

Preparation of Caustic Potash and Soda.—POLLACCI obtains the oxides of sodium and potassium by heating the respective nitrates of these metals with three times their weight of iron filings, when the iron becomes oxidised and nitrogen is given off.

WOHLER uses copper for the same purpose.—*Gazzetta Chemica Italiana*, 1872.

Bachet's Process for Manufacturing Caustic Soda.—CLAPHAM AND BALL state that this process has not yet been worked out successfully in a pecuniary point of view. It consists mainly in the application of the process of Losh, viz., the re-action of litharge and common salt on each other, thus producing lead chloride and caustic soda. By the addition of lime to these materials a larger yield of caustic soda is obtained, but even in this case not more than eight per cent. of the sodium chloride can be converted into caustic soda on a manufacturing scale. The separation of the caustic soda is a matter of difficulty, but by saturating it with carbonic acid gas bicarbonate of soda is produced which can be separated without difficulty; this modification of the process, however, does not pay, at any rate in England, where fuel is comparatively cheap. The loss of lead in this process need not exceed 0·5 per cent., which represents about 20*s.* per ton of caustic soda manufactured.

By carefully fishing out the sodium chloride crystals from the caustic soda leys as they evaporate a caustic soda of from 40 to 70 per cent. can be obtained; the cost of manufacturing a ton of caustic soda at 70 per cent. is thus estimated:

	£	*s.*	*d.*
Wages	3	2	2
Coals	3	18	0
Salt	1	11	9
Lime	0	17	3
Carbonic acid	0	1	7
Loss and deterioration of lead	0	17	3
Loss of soda	0	8	3
Repairs	0	8	3
Water	0	4	0
Casks	0	16	5
Nitrate of soda	0	6	6
	£12	0	0

Management, taxes, and rent, &c., to be added.—*Proceedings of the Newcastle-on-Tyne Chemical Society.*

Preparation of Potash, Soda, or Baryta, from their respective Sulphides.—TESSIE DU MOTHAY treats the sulphides with oxide of lead, whereby lead sulphide is formed, and the caustic alkalies: from the lead sulphide the lead is recovered by treating with hydrochloric acid, which gives lead chloride and sulphuretted hydrogen, which is burnt to make vitriol; the lead chloride is decomposed by magnesia or lime, which reproduces the lead oxide; the resulting magnesium chloride is heated in a current of steam, whereby hydrochloric acid is given off.

Another process is to boil the sulphides with potassium, sodium, or barium silico-fluoride; sulphuretted hydrogen is evolved, and silica is deposited, the fluorides of the alkali-metals being formed; these are decomposed by lime (or carbonate of lime), whereby calcium fluoride and caustic alkali (or its carbonate) are obtained; or by carbonate of barium and carbonic acid. Oxide of zinc may be substituted for oxide of lead. *Berichte der Deut. Chem. Ges. v.* 741.

Recovery of Soda, Potash, &c., from Soap-leys.—TESSIE DU MOTHAY adds carbonate of calcium, barium, or magnesium to the liquors which have served for the extraction of grease, &c., from wool and silk, and leads carbonic acid gas into the liquor; the organic matters are precipitated with the excess of carbonate; the liquors are evaporated down, or else barium hydrate is added, and the resulting barium carbonate separated by subsidence; caustic alkalies are thus reproduced, and the last traces of organic matter are removed by the precipitated barium carbonate. *Berichte der Deut. Chem. Ges. v.* 739.

Preparation of Caffeine.—AUBERT finds that treating coffee-berries with chloroform gives a larger yield of caffeine than any other method, from 0·709 to 0·849 per cent. of the alkaloid being thus found in the raw berries.

When Java coffee is roasted until it becomes of a clear brown colour, no caffeine is expelled in the vapours evolved; but if the roasting be carried further caffeine is volatilized and condenses in crystals.

The chloroform method is also applicable to tea. The author finds that an ordinary cup of "good coffee" and one of "good tea" both contain about the same quantity of caffeine, viz., 0·10 to 0·12 grammes. *Der Naturforscher*, 1872, *No.* 30.

Preparation of Potassium Borofluoride. — 156 grammes of fluor spar, 62 of crystallized boric acid, and 327 of crude hydrochloric acid, with half as much water by volume, are heated for two or three hours, and potassium chloride added to the product; about 35 grammes of potassium borofluoride is precipitated, and may be purified by recrystallization from a boiling ammoniacal potash solution. *Chem. Centralblatt*, 1872, 395.

Manufacture of Potassium Ferrocyanide.—WENZELL takes

1	part	potassium dichromate
8·58	„	crystallized potassium ferrocyanide
3	„	hydrochloric acid of sp. gr. 1·16

The two salts are dissolved in 60 parts of hot water, the acid added, and the whole boiled until a sample of the liquor gives no blue colour with ferric salts; the whole is then filtered from separated chromic oxide, and allowed to crystallize. *Vierteljahrschrift für Praktische Pharmacie*, 1872, 243.

Adulteration of Cream of Tartar.—J. M. MERRICK states that he has found seventy-seven per cent. of alum in commercial cream of tartar. *American Chemist, iii.* 180.

Beetroot Ash. — PFEIFFER states that the potassium chloride obtained from the ash (partly existing as such, and partly formed by the action of calcium chloride on the carbonate present in the ash) can be employed in the manufacture of potassium nitrate. After all crystallizable salts have been removed the final mother liquors contain much potassium sulphocyanide, and small quantities of iodides and bromides, and of compounds of rubidium. *Chem. Centralblatt*, 1872, 201.

Rubidium in Beetroot Ashes. — GRANDEAU finds that beetroot ashes contain not inconsiderable quantities of rubidium. He was able to extract from one kilo. of ashes 1·75 grammes of rubidium chloride. *Arch. der Pharm. cc.* 100.

Solubility of Silicate of Soda.—It is well known that this salt is largely used in the manufacture of soap for the purpose of increasing the hardness of the material as well as its alkalinity. Experience showed that a water-glass solution containing a greater proportion of silica was better suited for the named purpose than one less rich in silica. G. SCHNITZER has made a series of experiments in order to determine to what extent the ratio of silica in water-glass may be increased without the solubility of the latter being diminished. The following table shows the proportion of the substances employed in the trials :

Number of Experiments.	Mixture in Crucible.	Per-centage of Na_2CO_3 in the Soda.	Proportion of Na_2O to Si_2O in the product of the fusion.
1.	330 parts sand. 120 „ calc. Glauber 20 „ coke [salt		1 : 3·2
2.	120 „ soda 180 „ sand	83·6	1 : 2·64
3.	100 „ soda 180 „ sand	91·0	1 : 2·9
4.	110 „ soda 160 „ sand	95·0	1 : 2·6
5.	120 „ soda 172 „ sand	80·4	1 : 2·7
6.	120 „ soda 160 „ sand	90·0	1 : 2·8

The sand was free from lime, and contained only traces of iron. The fused mass from experiment (1) dissolved only with difficulty, but the products of the experiments (2) to (6) dissolved much more easily in boiling water, and among them (3) showed the greatest solubility. *Dingler's Polytech. Journal, cciii.* 129.

Soap free from Caustic Alkali.—MIALHE obtains a superior quality of soap, by treating soap prepared in the cold with excess of alkali, with carbonic acid. The alkali is transformed into bicarbonate, but the soap retains its softness through the presence of glycerine. *Ber. Deutsch. Chem. Ges. v.* 1057.

Bismuth Sub-nitrate.—EKIN finds that the officinal preparation frequently contains silver in the form of a chloride (sub-chloride), and sometimes in the metallic state ; the source of this silver is of course the metallic bismuth employed. *Moniteur Scientifique Quesneville, Feb.* 1873.

§ 2.—*Metallurgy.*

Iron Mines of Algeria.—MENE reports on the quality of the ore from Soumak in Algeria ; they vary from 47 to 65 per cent. Manganese is usually present. The ores being readily accessible and not far from the sea-coast, with which, moreover, the mines are connected by rail, it appears not improbable that Algeria may become an important iron-producing country. *Revue Hebdomadaire de Chimie Scientifique et Industrielle.*

Andorra Iron Ores.—FLOBERT has examined specimens of ores from this neighbourhood, with the following results :—

	No. 1.	No. 2.
Water	7·240	8·600
Peroxide of iron	87·215	74·130
Silica (insoluble in acids)	3·103	10·600
Manganese	0·350	0·165
Earthy matter (soluble in acids)	2·092	6·495
	100·000	100·000
Metallic iron	74·130	51·900

Revue Hebdomadaire de Chimie Scientifique et Industrielle, Dec. 1872.

The Bessemer Process at Königin-Marien-Hütte, near Zwickau.—From 4,800 to 5,000 kilogrammes of pig-iron are melted in a Krigar's cupola, and are transferred to a converter with seven air-tubes 1 centimetre in diameter ; the blast is at a pressure of 1 metre of mercury. Spectrum observations on the flame that issues exhibit the presence of sodium throughout the whole process ; after some short time the potassium and lithium lines appear in the red and violet ; two minutes after the commencement of the "blow," manganese lines appear. The blast being cut off by tilting the converter, a sample is drawn with a cold iron rod, to which the cinder and a portion of the steel adhere. This is plunged in cold water, and then examined.

The amount burnt away is about 9 per cent. The ingots are hammered under a steam hammer weighing 15·000 kilogrammes. *Der Berggeist*, 1872, *No.* 2.

Production of Spiegeleisen.—FORBES thus describes the production of spiegeleisen. The ores from which the spiegeleisen is prepared in Germany, Russia, and Sweden, contain iron and manganese, either in actual combination with one another, or at least very intimately mixed together. If the attempt be made to produce spiegeleisen artificially by fusing together iron and manganese, this condition must be strictly observed, otherwise the manganese shows a tendency to pass into the slag. Since, further, the oxides of manganese are less easily reduced than those of iron, the reducing capacity of the furnace ought to be as great as possible. The following points must be specially observed in order to obtain good results:—

1. The manganese ore used should contain a large proportion of iron, in order to ensure the easy reduction of the greatest possible proportion of manganese.
2. The furnace charge should be basic, which may be effected by using excess of limestone, or, better, of burnt lime.
3. The smelting operation should be conducted more slowly than in the ordinary process, in order to give more time for the reduction of the manganese oxides.
4. The furnace temperature ought to be as high as possible, and the blast as hot as possible. As coke can bear a stronger pressure of blast, and developes more heat than charcoal, it should be used in preference.

FORBES also gives details regarding the manufacture and composition of some of the better-known varieties of spiegeleisen which are imported from abroad.

The material produced in Nischne-Tagilsk, in Russia, and noted for its excellency, is got from a mixture of native iron oxides, containing some manganese and braunite, containing about 40 per cent. of metallic manganese and 10 per cent. of iron. The fuel used is wood-charcoal.

In Sweden, chiefly in the Dalekarlia district, a mixture of knebelite and garnets, containing about 13 per cent. of manganese, serves as raw material for the production of spiegeleisen. The ores are mixed with 30 per cent. of limestone, and the smelting performed by wood-charcoal and coke mixed in equal proportions. It deserves to be mentioned, that though the ores are visibly contaminated with iron pyrites, zinc blende, and other metallic sulphides, the spiegeleisen obtained is free from sulphur.

The ores employed in Germany for the production of spiegeleisen are found in veins in the Devonian formation on the east bank of the Rhine. They are spathic ironstones, consisting of iron carbonate intimately mixed with manganese carbonate, and containing more or less copper and iron pyrites, with traces of zinc blende and galena. The metallic iron and manganese in them amount to about 42 per cent. and 7 to 8 per cent. respectively.

Observations with German furnaces have shown that coke is superior to either wood-charcoal or a mixture of wood-charcoal and coke, and that by its use there is obtained a spiegeleisen richer in manganese. It is hardly necessary to remark that in order to obtain such good results the coke must be free from sulphur. *Dingler's Polytech. Journal, ccv.* 220.

Substitute for Manganese in Bessemer Steel.—BENDER shows that the addition of spiegeleisen can have no other purpose than to neutralize the oxygen which the molten iron in the converter has retained after the blow. The possibility of the manganese acting as a purifier is contested on the ground that it carries off nothing but a little sulphur, not more, however, than a highly carburetted iron would take away. That the small quantity of manganese remaining in the iron—three-fourths to four-fifths of the added spiegeleisen go, as is well-known, into the cinder—has a beneficial effect upon the quality of the refined metal, is disputed by many experienced ironmasters. If then the main, if not only, advantage gained by adding spiegeleisen to the Bessemer metal is the elimination of the oxygen, the question presents itself whether that end could not be attained by some cheaper means. Bender proposes carbon—in the shape of coke free from deleterious substances, or still better, of wood-charcoal—as a substitute for the expensive manganese. He is fully aware of the drawback, that through the formation of carbonic oxide bubbles are produced in the metal, but he thinks that that is the case to almost the same degree in iron that has been treated with manganese. To avoid this disadvantage he advises to look out for a substance, which on being added to the metal, would combine with the oxygen forming a fusible cinder, and not a gas. After having neutralized the oxygen by that body, the necessary quantity of carburetted iron or spiegeleisen may then be added for the sake of recarburation. *Dingler's Polytech. Journal, ccv.* 531.

Crucibles for Melting Steel.—FEICHTINGER states that very durable crucibles may be made from the following mixture :—

Lixiviated ground porcelain . .	10 parts.
Graphite	10 „
Asbestos (in thread 3 millimetres long)	15 „
Powdered quartz	3 „
Fireclay	22 „

Bayerisches Industrie & Gewerbe Blatt.

New Process for Steelmaking.—BAJAULT and ROCHE cast a mixture of fused pig-iron and ore into ingots in metal moulds, so that the ingot becomes incorporated with the mould. The whole is then heated in a special kind of furnace to a bright red heat for some hours ; jets of carbon oxide are continuously evolved until the reduction is complete, when a crude steel is obtained which only requires melting either in crucibles or in a reverberatory furnace. The injurious action of the ore on the walls of the furnace is thus avoided, and hence the principal objection to the use of rich ores is done away with. Steel thus prepared had the following composition :—

Carbon (combined)	0·43
do. (uncombined)	0·08
Silicon	0·23
Phosphorus	nil
Sulphur	nil

and was strong and malleable, and became hard on annealing. *Comptes Rendus, Jan.* 1873.

Metallurgy of Manganese.—TAMM employs two fluxes composed as follow :—

No. 1.		No. 2.	
Powdered glass	63·0	Flux, No. 1	34·0
Quicklime	18·5	Good manganese dioxide	60·5
Fluor spar	18·5	Lampblack	5·5
	100·0		100·0

It is noteworthy that finely powdered wood-charcoal will not answer instead of lampblack. The crucibles used must be very refractory ; 3 parts of graphite, mixed with one of fire-clay, are used as a lining, being made into a paste with water, and spread over the interior. They are then charged with the following mixture :—

Good manganese dioxide . . .	1000
Soot or lampblack	91
Green flux (No. 2)	635
Oil sufficient to moisten the mixture	

and are gradually heated to a white heat in a wind furnace, and kept at that temperature for several hours. The manganese thus obtained contains 96 per cent. of that metal, with small quantities of iron and carbon, and traces of aluminium, calcium, phosphorus, sulphur, silicon : when refined by melting again with an eighth of its weight of manganese carbonate, it contains 99·9 per cent. of manganese with traces of iron, carbon, and silicon. *Chemical News, xxvi.* 111.

Quantitative determination of Silicon in Iron and Steel.—BOUSSINGAULT is inclined to pronounce the presence of silicon in iron and steel, like that of sulphur and phosphorus, as injurious to the quality of the metal. The ordinary methods of analysis are, however, of value only when the silicon in a given sample of iron or steel, amounts to at least a few centigrammes (in 100 grammes) ; where the quantity does not go beyond milligrammes these methods cease to be sufficiently safe, for it appears questionable whether the silica found comes from the silicon in the iron, or whether it may not have been introduced by the acids, or derived from the vessels in which the operations were executed. Boussingault has devised, therefore, a new process : the iron, reduced to filings or shavings, is placed into a little platinum tray, and is then heated for two or three hours in an assay furnace to the usual temperature of cupellation. The tray containing a mixture of protoxide and peroxide of iron and of silica, is then brought into a platinum tube, which is heated to redness, and through which a current of dry hydrochloric acid gas is passed. When all the iron has been carried off in the shape of chloride, the residual silica is to be taken out and weighed. Should the operation have been prematurely interrupted, which would be easily seen by the presence of some iron oxide in the tray, it can be again resumed without prejuducing the correctness of the analysis.

It had been attempted to shorten the whole operation, by exposing the sample to be determined to the simultaneous action of air and hydrochloric acid, but the trial proved unsatisfactory since some of the silicon was carried away as chloride, before it could combine with oxygen.

A detailed account of numerous analyses is given by Boussingault ; he gives the following table of the per-centage amount of silicon in some well-known kinds of iron and steel.

	Silicon in 100 parts.
Swedish iron, sample I.	0·00164
Do. do. do. II.	0·00187
Refined iron from Unieux (France), sample I.	0·00093
Do. do. do. do. II.	0·00090
Chinese steel	0·00070
Cast-steel from Krupp's factory . . .	0·00440
Steel for watch-springs	0·00040
Wootz steel	0·00062

Dingler's Polytech. Journal, cciii. 209.

Quicksilver, Extraction at New Almaden (California).—The ores are treated as at Idria, *i. e.*, are roasted in large shaft-ovens with layers of wood intervening ; the mercurial vapours are condensed in walled chambers, the lime in the ores greatly facilitating the expulsion of the metal. Two million kilogrammes are produced yearly, at a cost of 300 francs per 100 kilogrammes. At Almaden, in Spain, the yearly make is one million kilogrammes, costing 1,000 to 1,200 francs per 100 kilogrammes.—*Polytech. Centralblatt*, 1872, 139.

Refining of Gold.—E. DUMAS gives a description of the method by which the gold is purified at the Royal Mint in London, viz., the well-known process, whereby the impurities of the gold are eliminated by conducting chlorine gas into the molten metal. *Dingler's Polytech. Journal, ccv.* 335.

§ 3.—*Dyeing, Calico Printing, Bleaching, and allied Subjects.*

Improved Soluble Aniline Black-Blue for Woollens, Cottons, and mixed Fabrics.—From 1 to 4 pounds of Schuchardt's aniline black-blue are employed to 100 pounds of fabrics, the dye being dissolved in three to four times its weight of water containing 1 per cent. of sulphuric acid, or a sufficient quantity of acetic acid ; the goods are then passed through the bath at 90°, the quantity of dye solution added to the water depending on the tint required. Cottons and half-stuffs must be previously mordanted with tannic acid. Tints from the clearest to the darkest blue are thus obtainable.—*Polytech. Centralblatt*, 1872, 333.

Iodine Aniline Colours.—GROTHE prepares aniline violet (tri-ethylated rosaniline) by heating together

40 kilogrammes fuchsine (as pure as possible)	
30 „	caustic soda
120 „	ethyl iodide

The fuchsine is placed in a boiler with half the soda, and a little alcohol, and the whole agitated ; half of the iodide is then added, and the whole boiled, an inverted condenser being attached : after six hours the remainder of the soda and iodide of ethyl are added, and the whole heated for six to eight hours more ; the excess of ethyl iodide is then distilled off, and the

pasty mass left in the digester boiled with strong caustic soda solution; the violet mass left is purified by solution in 20 kilogrammes of sulphuric acid diluted with 20 of water, precipitation by soda, washing, solution in boiling water, and precipitation by common salt.

POIRRIER prepares a similar violet by oxidising trimethylated aniline, prepared by heating wood spirit with nitrate of aniline in sealed vessels: this dye is trimethylated rosaniline.

If an increased pressure be used in the first process, a green dye is also formed, due to a secondary action. *Chemisches Centralblatt, iii.* 25.

Fabrication of Aniline Colours.—GIRARD AND DE LAIRE prepare blue colouring matter without the use of arsenical preparations in any form, by treating diphenylamine with carbon sesquichloride in enamelled retorts, at a temperature of 160° to 180° for 3 to 4 hours: hydrochloric acid is formed, and carbon chloride distils over; when the production of the latter ceases, the operation is at an end. The crude dye is purified by solution in two parts of lukewarm aniline, and the solution gradually added to 12 parts of benzene; this operation may be repeated, and if greater purity is required, the substance may be dissolved in a dilute alcoholic solution of potash, and precipitated again by addition of an acid.

The diphenylamine required is formed by digesting ordinary aniline with an equivalent quantity of aniline hydrochloride in sealed vessels at 250° to 260° C. (*i. e.* at a pressure of 5 to 6 atmospheres), for 10 to 11 hours. *Comptes Rendus, lxxv.* 1556.

Arsenic in Aniline Colours.—SPRINGMÜHL examined samples of commercial fuchsine, and found the minimum percentage of arsenic was 0·25, the maximum being 6·5; other specimens, however, contained less than 0·25; that wool, dyed with even the most poisonous of these specimens, would not be practically injurious, was shown by the following experiments. A sample of fuchsine containing 6·5 per cent. of arsenic was dissolved in water and a square foot of pure wool dyed in the solution at 70° C.; the wool was rinsed in a separate vessel with pure water, and then again in a third vessel. Almost the whole of the arsenic originally present, was found to be contained in the first wash-water and the original dye-liquor, the latter containing far the most: the second wash-water, and the wool itself contained together only 0·0004 gramme of arsenic; and, as an examination with Marsh's apparatus showed that the water contained more arsenic than the dyed wool, it is evident that the wool could not have contained more than 0·0001 gramme of arsenic per square foot. Samples of fuchsine containing less arsenic than the one thus examined, gave correspondingly less amounts of arsenic in the wool dyed with them. *Musterzeitung*, 1872, No. 23.

Coralline.—This dyestuff, now much used in calico printing, &c., was first prepared for the market by Würtz, in 1864, the formula for its manufacture being

Carbolic acid	20
Oxalic acid	8-10
Sulphuric acid	6-12

the materials being simply heated together until the red colour appears: after the re-action is complete, the mass is well washed with boiling water and the viscid resulting mass is dried, powdered, and digested with ammonia salts at 150° C., for 3 or 4 hours: strong acids precipitate the coralline from the solution thus obtained.

Coralline is applicable to wool-printing, and can also be used as a dye for cottons mordanted with tin and sumach or tannin. *Dingler's Polytech. Journal, cciv.* 397.

Couleur de Rose.—SANDER AND SIECKE, of Zürich, have introduced a colouring matter into the market under this name. Yarns are previously washed with water-glass solution at 40° B., 15 to 20 litres of solution being required for 50 pounds of yarn. The dye-tub must be cold, and the goods require half to three-quarters of an hour's immersion, being then passed through a cold, faintly acid bath, which precipitates silica on the fibre, and thereby helps to fix the tint. *Polytech. Centralblatt*, 1872, 204.

Iodine Green for Linen.—1 lb. of alum and ½ lb. of sugar of lead are dissolved separately in water and the solutions mixed. In the resulting aluminium acetate the goods are soaked, and then dyed in a bath of aniline green, 1 lb. of the powdered dye being employed for every 60 lbs. of yarn. If a yellower shade be required, it can be given by means of picric acid. *Reimann's Farber Zeitung*, 1872, No. 30.

Indigoline.—This new dyestuff yields indigo-blue shades, and is soluble in boiling water. For woollens, alum or tartar and sulphuric acid, or sulphate of sodium and sulphuric acid, may be used as mordant, 8 grammes of dye sufficing for a kilogramme of wool. It is a good basis for dark green, Russian green, brown, and other shades. *Polytech. Centralblatt*, 1872, 478.

Black for Woollen Goods.—The articles to be dyed are boiled for about an hour and a half in a liquor containing 5 parts potash chromate, 2 parts copper sulphate, and 2 parts sulphuric acid, left in the bath over night, and then steeped in a solution containing Brazil-wood and sal-ammoniac. After lying for at least 12 hours in this second bath, the goods are taken out and well washed with urine. *Dingler's Polytech. Journal, ccv.* 387.

Anthraflavic Acid.—PERKIN has continued his researches on the substance produced simultaneously with alizarine in the manufacture of the latter from anthracene. He finds that it is isomeric with alizarine, but that its tinctorial and other properties are by no means identical with those of this body. *Journal of the Chemical Society* [2] *xi.* 19.

Bleaching of Jute.—50 lbs. of jute are treated with a soda bath at 60° C., containing 5 lbs. of soda, and are then immersed in a bleach-liquor made from 2½ lbs. of bleaching powder, with a little bitter-salt. After standing some hours the fibres are washed and tinted with indigo carmine. *Reimann's Farber Zeitung*, 1872, No. 30.

Removal of Fatty Matters from Wool, &c.—SIMONIN AND COFFIN allow the vapours of benzene, naphtha, or light petroleum distillates, &c. to pass through the wool; the vapour partially condenses and dissolves the fatty matter, which is thus removed. By distilling off the volatile hydrocarbon from the solution of fat thus obtained, the grease is obtained separately, and may be sold or otherwise employed. The vapour of the substance acts better than the cold hydrocarbon. *Le Technologiste, May*, 1872, 206.

[*Note by Abstractor.*—The use of the *hot* vapour cannot fail to have an injurious effect on the quality of the wool; *vide* article on *Woolscouring*, "Practical Magazine," 1873, p. 52 (January). C. R. A. Wright.]

Mordanting with Alum.—P. HAVREZ finds that very small quantities of alum produce the desired effect of depositing alumina hydrate in the fibres. By using larger quantities of alum solution, the previously-deposited alumina hydrate is redissolved. The practical consequence of employing too much alum, viz., the loss of brilliancy of colour, is thus sufficiently explained. The quantity of alum to be used for mordanting ought, according to the investigator, not to exceed one-tenth of the weight of the goods to be dyed. *Dingler's Polytech. Journal, ccv.* 491.

Distinction between Silk, Wool, and Vegetable Fibres in mixed Tissues.—E. KOPP gives a somewhat detailed account of the various re-actions employed for the above purpose.

All vegetable fibres (cotton, flax, hemp, &c.) resist the action of solutions of caustic alkalies, even when boiled with them, but dissolve easily in concentrated sulphuric, nitric, or hydrochloric acids, as also in dilute solutions of these acids when heated with them. There is, however, a remarkable exception to this rule, inasmuch as fuming nitric acid, or a mixture of nitric and sulphuric acids does not dissolve cellulose (which is the base of the various kinds of vegetable fibre), but converts it into pyroxylin, or gun-cotton. When burned, vegetable fibres give no peculiar smell.

Wool is not dissolved by acids, but easily by caustic alkalies, especially at high temperatures. Since sulphur is a constituent of wool, the solution thus produced contains an alkaline sulphide, and, therefore, turns black when mixed with plumbic acetate. On combustion wool emits the characteristic smell of burning horn.

Silk dissolves in concentrated acids, and also in alkalies, and, like wool, developes the odours of burning horn when submitted to heat. Unlike wool it is, however, free from sulphur, and therefore its alkaline solution contains no sulphide, and hence does not turn black on addition of plumbic acetate.

Both wool and silk differ from vegetable fibres in their capability of taking up certain colouring matters, without requiring previous treatment with mordants. The following process, based upon these re-actions, may be employed to distinguish from one another these three substances when occurring in mixed tissues.

The fabric is treated with cold concentrated hydrochloric acid, which dissolves out the silk; the undissolved residue is washed upon a filter, bleached, if required, by means of chlorine

water, washed again, and boiled in caustic soda, which takes up the wool, but leaves behind the vegetable fibre. The presence of wool is proved by adding plumbic acetate to the alkaline solution. *Dingler's Polytech. Journ. ccv.* 563.

[*Note by Abstractor.*—The solubility of silk in cold concentrated hydrochloric acid was first pointed out by Spiller, in a paper read at the Liverpool meeting of the British Association. At the same time the author recommended an aqueous solution of picric acid for the purpose of identifying the presence of wool in mixed textile fabrics.—R. GERSTL.]

New Tanning Materials.—The wood of the muskito tree and that of the live oak (which occur plentifully throughout the western part of Texas) are extremely rich in tannin, the extract made from the former containing 30, and that from the latter 50 per cent. of this substance. *Deutsche Gerber Zeitung.*

Tannin.—Instead of the usual decoctions of galls or of similar vegetable products, extract of Chinese galls is recommended as a mordant for every kind of textile fabrics. The advantages of its application are the saving of about 5 to 7 per cent. of colouring matter, greater purity and brilliancy of the colours, and considerable gain in time and labour. In order to prepare the extract, galls are powdered, and the powder shaken with three to four times its weight of alcohol and ether; the ethereo-alcoholic solution is distilled, and the remaining tannin dissolved in boiling water. The aqueous solution is left to settle for about twenty-four hours, when a green resinous matter collects on the surface of the solution; this is removed, and the solution evaporated to dryness, and the residue then pulverized. The tannin thus obtained is easily soluble in water. Where the employment of ether is considered too expensive, alcohol alone may be used; the product in this case will be less free from brown colouring matters, but is otherwise sufficiently good for many practical purposes. *Würtemb. Gewerbebl.* 1872, *No.* 37. *Dingler's Polytech. Journ. ccv.* 576.

The Technology of Tanning Materials.—WAGNER refers to the uncertainty in the meaning of the term *tannin* as applied to tanning materials, inasmuch as various substances, some of the nature of glucosides, others not containing any glucose, are all classified under this name. A resumé of researches on the chemical nature of tannin and its relations to gallic acid is given, from which the author infers that the technical value of processes for estimating so-called "tannin" (the nature of the component parts of which is utterly unknown) is of very questionable value. *Deutsche Industrie Zeitung*, 1872, *Nos.* 11 *and* 12.

Kangaroo and Alligator Leather.—Hides of kangaroos have been imported into St. Francisco from Australia, and examined by tanning: the leathers thence made are very thin and tender, and much more supple than calf leather, and will stand rain better. Alligator hides from Mexico and Central America are frequently used for strong and waterproof shoes and boots. *Polytechnisches Centralblatt*, 1872, 1027.

Cadmium Sulphide as Colouring for Soap.—The tinctorial power of this colouring matter is so great that its price is a matter of no moment; it is, however, essential that the substance should be pure, which is not always the case with the commercial article; zinc-white has been found as an adulterant; this may conveniently be detected by digesting with acetic acid and adding carbonate of sodium solution to the filtered liquid; if zinc be present a white precipitate falls. *Polytech. Centralblatt*, 1872, 269.

Bleaching by Means of Ozone.—DAVID employs as ozone generator a mixture of permanganate of potassium, manganese dioxide and sulphuric acid contained in carboys: air is passed over the mixture, and after becoming impregnated with ozone is led into a brick tank containing the substances to be bleached: after several hours' exposure to the air, cotton, flax, rags for paper-making, &c., are sufficiently bleached. *Revue Hebdomadaire de Chimie Scientifique et Industrielle. Dec.* 1872.

§ 4. *Food and Sanitary Matters.*

Clearing of Wines.—GRAGER states that wines which will not spontaneously clarify themselves by standing may be cleared by the addition of isinglass, tannin or white of egg. The amount and nature of the clearing material requisite is known by taking a sample of the wine and making preliminary trials with it; to a known bulk of the wine (200 ccs.) is added a portion of isinglass solution of known strength (five drops), to another equal bulk twice as much, to another three times, and so on: the various mixtures are then well agitated and allowed to stand for twenty-four hours; should no precipitate be found in any case, isinglass is not suitable as a clearing material, and tannin, or tannin together with isinglass, &c., &c., is to be tried in a similar way. Should a precipitate be found, some of the clear liquid is syphoned off and tested again similarly with five drops more of isinglass solution: in this case, if the first solution gives no precipitate after twenty-four hours with the second treatment, the original five drops were sufficient; if the first gives a precipitate and the second not, the amount of isinglass solution requisite lies between five and ten drops, and so on. Hence the quantity required to clarify a caskful can be readily computed; on an average about one part of isinglass to 10,000 or 12,000 of wine is requisite.

Other materials are occasionally used, but these are frequently more costly and much more delcterious than the above; powdered wood charcoal not merely clarifies by removing suspended matter, but also absorbs colouring matter and the essential oils which yield the peculiar bouquet. *Polytechnisches Centralblatt*, 1872, 129.

Red Wines.—COTTINI and FANTOGINI propose the following test for the colouring matter of wines in order to decide whether it is really due to the grape skins or to other substances. 6 ccs. of nitric acid of sp. gr. 1·41 are mixed with 50 ccs. of wine, and the whole heated to 90° or 95° C. Genuine wine retains its colour for an hour under these circumstances, whilst the colouring matter of the bilberry (the most usual red colorant employed) is bleached in a few minutes.

STEIN considers this test worthless. *Pharmaceutische Centralhalle*, 1872, *No.* 27.

Treatment of Wine with Sulphuric Acid.—L. DE MARTIN finds that the addition of from one to three grammes of sulphuric acid to the hectolitre of must causes more rapid and complete fermentation together with a marked improvement in the colour. On analysis no increase in the sulphates contained appears to result (the musts having been previously heated with plaster of paris, or *plâtrés*); the action of the acid appears from the experiments of Chancel to be due to the prevention of the least trace of alkalinity, which exerts a very injurious action on the fermentation, causing the production of lactic acid instead of alcohol. *Revue Hebdomadaire de Chimie Scientifique et Industrielle.*

Alcohol from Sawdust.—ZERETTLUND states that by heating wet sawdust (9 cwts.) with hydrochloric acid of sp. gr. 1·18 (10·7 cwts.) and water (30 cwts.) in a boiler heated by steam for eleven hours there was produced grape sugar equal to 19·67 per cent. of the wood; the acid liquor being nearly saturated with chalk and fermented with yeast for twenty-four hours, furnished on distillation 26·5 litres of 50 per cent. alcohol (about proof spirit): the alcohol was free from any turpentine-like odour, and had a good taste. Without doubt a little further experience would enable the manufacturer to obtain even far higher yields. *Moniteur Scientifique Quesneville*, *No.* 370, 1872.

Removal of Fusel Oil by means of Ozone.—WIDEMAN states that he succeeded in destroying the fusel oil spirit obtained from barley or from Indian corn in a very effective manner. The operation requires only fifteen to twenty minutes. Quite recently produced whisky thus treated had the taste and smell of a ten-years old article. *Dingler's Polytech. Journal*, *ccv.* 577.

Action of Yeast on Sugar Solutions.—GUNNING finds that when yeast is diffused through glycerine, and filtered by means of a Bunsen's water-pump, a filtrate is obtained containing a soluble albuminoid coagulable by heat, and capable of exciting fermentation; the cellular substance left on the filter exhibits no change under the microscope, but no longer possesses the power of setting up fermentation; on wetting it with the filtrate, however, this power is regained: hence apparently the action of yeast is due to a soluble albuminoid. *Berichte der Deut. Chem. Gesells. v.* 821.

Detection of Picrotoxin in Beer.—BLAS recommends that the beer should be evaporated to a small bulk, being previously saturated with soda; the liquid is then agitated with ether, which dissolves the hop-bitters; to the aqueous portion an acid is added, and the whole shaken again with ether; the picrotoxin dissolves in the ether, and may be obtained by evaporation, and identified by its properties, and notably by its poisonous action on fish, which are not affected by lupulin from hops. *Chem. Centralblatt*, 1872, 441.

Koumiss.—SUTERNAEF has examined a specimen of koumiss manufactured at Davos, in imitation of the genuine

Russian koumiss from fermented mare's milk; it contained in, 100 parts—

Water	90·346
Alcohol	3·210
Lactic acid	0·190
Sugar	2·105
Albuminoids	1·860
Butter	1·780
Inorganic salts	0·509
Free carbonic acid	0·177

and was probably manufactured by adding sugar to skim-milk, and fermenting by means of yeast. *Berichte der Chem. Gesells. v.* 286.

H. and R. SCHULTZE state that koumiss is prepared at Cracow by adding to unskimmed cow's milk as much milk sugar as would generate four atmospheres pressure if fermented in a closed vessel; well washed beer yeast is then added, and the whole partially fermented in an open vessel; half of the separated curd is then removed, and the rest of the fermentation conducted in well-corked champagne bottles. *Industrie Blätter*, 1872, *No.* 35.

SCHWALBE employs 100 ccs. of condensed milk dissolved in a little cold water, adds 1 gramme lactic acid, 0·5 gramme of citric acid dissolved in a little water, and 15 grammes of rum; the whole is then diluted with water to 1,000 to 2,500 ccs. The fluid is then impregnated with carbonic acid in a Liebig's apparatus, and allowed to stand two to four days in a warm place; if a strong effervescence ensues on opening, the liquor is in good condition, and remains so for a week. *Neues Jahrbuch für Pharmacie*, 38, *pa.* 14.

Borax as an Antiferment.—BÉCHAMP has examined the preservative action exerted by borax in stopping the action of yeast and yeast-water on sugar solutions; he finds that the antifermentative power of borax is great, but that boric acid itself is not the cause of the phenomenon. Bicarbonate of soda also checks the fermentation; one drop of creosote added to 100 ccs. of fermenting liquid has no impeding action either on the fermentation or on the inversion of the sugar. *Comptes Rendus, Oct.* 1872.

[*Note by Abstractor.*—Experiments on various antiseptics made a short time ago by the abstractor showed, *inter alia*, that the action of yeast upon a syrup containing 200 grammes of cane sugar per litre is not wholly stopped until nearly 1 part of pure carbolic acid is added to 100 parts of syrup; 0·2 to 0·3 parts of carbolic acid, however, greatly retard the fermentation, which is scarcely perceptible until the lapse of eight or ten hours. These quantities of carbolic acid, however, exhibit a far greater preservative action on white of egg or raw meat, decomposition being completely prevented for many days, even in very hot summer weather.—C. R. A. WRIGHT.]

Lemonade Powder.—A powder much used in Holland, consists of 2 grm. citric acid and 60 grm. of sugar, mixed with a drop of oil of citron. *Dingler's Polytech. Journal, ccv.* 580.

Adulterated Coffee and Cocoa.—ERCKMANN has found coffee coloured with extract of buckthorn berries (sap green); and has noticed large additions of potato starch to cocoa, the starch granules being readily visible under the microscope. *Gewerbeblatt für das Grossherzogthum Hessen*, 1872, *No.* 15.

Adulteration of Tea.—The British Consul at Shanghai (Medhurst) states that China tea is extensively mixed with the leaves of the willow gathered in April and May, and dried in the ordinary tea ovens in the same way as tea; this sophistication is often practised to the extent of 10 or 20 per cent. *Polytech. Centralblatt*, 1872, 404.

Preservation of Eggs.—GAFFARD places fresh eggs in a basin containing a solution of alum in its own weight of water, the temperature being 45° to 50°; after thirty to forty minutes the eggs are withdrawn and placed to drain; the alum solution is then made to boil, and the eggs then again immersed for ten to fifteen seconds, after which they are allowed to drain, and when cool packed in some substance which prevents the rapid renewal of the surrounding air, such as sawdust, ashes, &c. Eggs thus preserved will keep for a year. *Bulletin de la Soc. d'Encouragement, Nov.* 1872.

A Saccharo-chromoscope.—C. STAMMER believes that a comparative examination of the colours of syrups, or similar saccharine solutions, may be useful in estimating the amounts of sugar contained in such liquors, and he has devised an instrument for that purpose. *Dingler's Polytech. Journ. cciii.* 137.

Chloralum.—FLECK reports on chloralum solution, chloralum powder, chloralum wool and wadding supplied by the Chloralum Company, London. The solution contains—

Water	82·32
Lead chloride	0·15
Copper „	0·10
Aluminium „	13·90
Iron „	0·42
Calcium „ } Calcium sulphate	3·11
	100·00

and its price (in Dresden) is more than sevenfold its real value.

The chloralum powder contains—

Arsenic chloride	0·72
Lead „	0·55
Copper „	0·37
Aluminium „	52·43
Iron „	1·55
Calcium „	11·51
Calcium sulphate	0·72
Silica and alumina	32·15
	100·00

and its price (in Dresden) is fivefold its real value, whilst that of the wadding is forty times its true value.

The fact that arsenic, lead, and copper are contained is a strong point against the medicinal use of such substances: direct experiments on the comparative precipitating power for sewage of chloralum, and other cheap substances, gave the following results:

Calcium chloride disinfected	1000	of sewage.
Quicklime „	84·6	„
Alum „	80·4	„
Iron-vitriol „	76·7	„
Chloralum „	74·0	„
Magnesium chloride „	57·1	„

As a disinfectant, therefore, chloralum has no pretensions to superiority; it may be classed among the worthless secret preparations, against which the interests of health and commerce require the public to be warned. *Polytech. Centralblatt*, 1872, 479, *from Industrie-Blätter*, 1872, *No.* 4.

Use of Zinc for Tinning.—MENÉ states that the use of zinc instead of tin for lining copper culinary vessels is on the increase. Such a coating is recognizable by boiling vinegar in the vessel when corrosion will take place if zinc were used, but not if tin were employed, inasmuch as zinc is thus readily acted on; as its compounds are more or less poisonous and injurious, the practice of substituting zinc for tin in such cases is extremely reprehensible. *Revue Hebdomadaire de Chimie Scientifique et Industrielle.*

[*Note by Abstractor.*--Even vessels lined with tin may be sometimes injurious, owing to the circumstance that an alloy of lead and tin is sometimes used instead of pure tin for covering the inner surfaces, lead being thus occasionally conveyed into food.—C. R. A. WRIGHT.]

Utilization of Human Ordure as Manure.—JEAN adds to 100 parts of fæces (containing no other aqueous substance than urine) 10 parts of strong sulphuric acid and 13 parts of coprolites, containing 45 per cent. of tricalcium phosphate. The mass is well stirred, and 50 parts of sawdust and 27 of ashes (coal, peat, or wood) added as a drier; after some days the mass is pulverulent, and has the following average composition:

Water lost at 100°	14·8
Organic matter and water lost at 200°	53·6[1]
Mineral matters	31·6[2]
	100·0

[1] Containing of nitrogen 1·55.
[2] Containing of soluble phosphate 1·87.

Moniteur Scientifique de Quesneville.

Fireproof Paint for Wood.—Two substances are in general use for the purpose of protecting wood against combus-

tion, viz., zinc chloride and soda silicate. Both of these have certain drawbacks. A paint consisting of zinc chloride volatilizes when the material on which it is spread is heated or exposed to flame, and its vapours are insupportable by human beings. It would, therefore, be difficult, if not altogether impossible, to enter wooden dwellings painted with the zinc salt, when on fire, and thus the salvage of furniture, etc., would be obstructed. The water-glass paint, on the other hand, is liable to be washed away when exposed to rain or other watery influences. FR. SIEBURGER recalls, therefore, to mind, two fireproof compositions which were formerly in much use. The one is a saturated aqueous solution of 3 parts of alum and 1 part of copperas, with which the wood is twice painted; after drying, a solution of copperas in which powdered clay is suspended, is brushed over the alum layer. The other protective paint is a mixture of 1 part of sulphur, 1 clay, and 6 copperas, spread as powder over wood previously washed with a solution of glue. *Dingler's Polytech. Journal, ccv.* 278.

Preservation of Wood.—HOCK dissolves paraffin in ligroin, so-called petroleum ether, kerosene, or other convenient substances, and immerses the wood to be preserved in the solution, care being taken that the wood is as dry as possible. After impregnation, the saturated wood is heated in a large retort provided with a condensing arrangement whereby the volatile solvent is expelled and condensed for use over again, whilst the paraffin is left in the pores of the timber. Crude paraffin (containing much liquid hydrocarbons) may be employed. *Zeitschrift für Berg & Hüttenwesen*, 1872, *No.* 16.

§ 5.—*Illumination, Photography, Fuel, etc.*

Oxygen Illumination.—CARL describes a lamp whereby a most brilliant light is obtainable. It consists essentially of a circular petroleum lamp, the reservoir of which is filled with a solution of naphthalene in petroleum. Concentrically within the cylindrical burner rises a vertical tube surmounted with a cap pierced with radiating holes like the "rose-burner" of the laboratory. By means of an india-rubber tube oxygen is led from a gasometer into the centre of the circular flame, passing up the vertical tube. The lamp being lit, a smoky flame is produced at first, but on turning on the oxygen a brilliant star of light results. *Polytechnisches Centralblatt*, 1872, 729.

Purification of Glycerine.—In many continental cities, especially in Germany, glycerine is used instead of water to fill up the gas-meters, because it is not liable to freeze. By long-continued use, however, it becomes contaminated with ammonia, acids, tar, etc., and is then injurious to the metal of the meter as well as to the gas. The following method is recommended for its purification: the impure liquor is gradually heated up to 120°-130° C., and maintained at this temperature until no more ammonia and acids escape. The glycerine is then drawn off and filtered through a layer of charcoal. A charge of about 3 cwts. can in this manner be purified in 14 to 18 hours, and the expenses run to but little more than a shilling per cwt. *Deutsche Industriezeitung, No.* 30, 1872. *Dingler's Polytech. Journal, ccv.* 273.

Estimation of Paraffin in Stearin Candles.—HOCK saponifies the mixed paraffin and stearine with potash, precipitates by addition of common salt, and filters after cooling. The potash salt is left on the filter mixed with the paraffin, and can be separated by washing with cold water, which dissolves the potassium stearate; the paraffin is dissolved off the filter by ether, and the etherial solution evaporated to dryness and weighed. *Dingler's Polytech. Journal, cciii.* 313.

Paraffin-Oil Gas.—HUBNER has previously described a vertical retort which he has invented for the generation of gas from waste products of the coal-tar industry, &c. The condensers and other portions of apparatus are the same as in coal-gas-making; with the differences that the cooling-tubes are less numerous, as there is no steam to condense along with the tar, and that purifiers are not requisite. The gas produced has at least three times the illuminating power of coal-gas, although its quantity and quality necessarily vary according to the temperature employed and other circumstances. The highest temperatures feasible are the best for the manufacture of gas of this description.

The tubes used for gasifying the oil must not be too wide, otherwise the oils are apt to be insufficiently heated; 7 to 8 feet in length is required at the least. *Polytech. Centralblatt*, 1872, 190.

European Petroleum.—FEICHTINGER states there are extensive oil-bearing strata in Galicia, and that well-boring is being actively pursued in many localities. The main oil-bearing stratum lies from 1,000 to 1,500 feet below the surface. The petroleum is in every respect like that found in America. *Baeyerisches Industrie Gewerbe Blatt, Dec.* 1872.

Solidification of Mineral Oils.—TROOST describes the process of JORDERY by which mineral oils are transformed into a semi-solid mass, and thus made less dangerous during transport. It consists in stirring the oil with an aqueous extract of soap-wort (saponaria officinalis) until a gelatinous, semi-solid mass is obtained. This product, when ignited, burns with only a languid flame, which is easily extinguished. The expense for thus treating the oil is small—it would increase the price of the hectolitre of oil by not more than 1½ francs. *Monit. Prod. Chim.* 10 *Dec.* 1872.

Ceresine.—MÉNE states that in the manufacture of ozokerite of Austria a bye-product much resembling wax is obtained. It is a hydrocarbon destitute of taste and smell, melting at 61°-63°, and of specific gravity 0·88; it is semi-transparent, and can be used instead of wax for many purposes; it is insoluble in water, but soluble in alcohol; unlike fatty bodies, it cannot be saponified by alkalies. *Revue Hebdomadaire de Chimie Scientifique et Industrielle, Nov.* 1872.

New Photometer. — PROVENZALI has constructed a photometer consisting of two thermometers, one filled with mercury and one with a solution of iodine in carbon disulphide: when examined in the dark the indications of the two are identical; but when exposed to light the iodine thermometer exhibits a higher temperature than the other, the difference between the two being greater the more intense the illumination, on account of the visible rays being more completely absorbed and converted into heat. *Les Mondes.*

Chemical Action of Sunlight. DEWAR calculates the dynamical efficiency of sunlight in producing the growth of green foliage; starting from the datum that a square decimeter of green leaf decomposes on an average 5·28 ccs. of carbonic acid per hour (Boussingault) it is calculated that the ratio of the actual quantity of energy stored up in the plant-leaves to that radiated from the sun at Paris is about 1 to 238 as a minimum. *Philosophical Magazine* [4], *xliv.* 307.

Merget's Photographic Printing Process.—Ordinary collodion positives are exposed to the vapour of mercury which condenses on and adheres to the silver just as in the daguerreotype process; the prepared photographs are then pressed against paper impregnated with soluble salts of silver, gold, palladium, iridium, platinum, &c., the nitrate of the first-named metal and the chlorides of the others answering well (in the case of silver, the printing must be performed in the dark, otherwise an imperfect copy is produced from the action of the sunlight.) The mercury quickly reduces the salt of the other metal, and gives a copy where the lights and shadows are well represented; in order to fix the print all that is required is to wash the paper thoroughly; in the case of silver prints, toning and fixing may be accomplished as in ordinary copies produced by the aid of light. *Dingler's Polytech. Journal, cciii.* 385, *and cciv.* 231.

Encaustic Photography.—J. VON DER FORST employs the following solution as sensitizer:—

Rainwater	200
Dextrin	10
Grape sugar	12
Ammonium dichromate .	15

The dextrin being first dissolved, then the grape sugar, and lastly the chromate: the ammonium salt gives finer details than potassium dichromate. The solution is used fresh and warm; if kept, it must be preserved in a dark room and warmed before use: the plate must be absolutely dry before use, ten to fifteen minutes' exposure being required; after exposure the plate is carefully dried, and then so far developed that the image is visible; after standing for an hour, it is warmed again, when the development is complete in a few seconds. Much flux must be added to the colours used to make them vitrify quickly and take a high lustre. *Polytech. Centralblatt.* 1872, 330.

Pyrophotography.—OIDTMANN recommends the preparation of photographic images on glass, porcelain, etc., and fixation of the same by covering with colouring glaze, and subsequently burning in. Designs and pictures thus obtained, are said not to be distinguishable from those done with the brush. *Dingler's Polytech. Journal, cciii.* 489.

Production of Coke.—BALLING publishes a comparative study of the various furnaces employed in the production of

coke in Germany, and pronounces the furnaces after Coppée's system as the most practical. *Dingler's Polytech. Journal, cciii.* 272.

Occluded Gases in Coal.—E. VON MEYER has investigated some samples of English coals, with the view of determining the nature and proportionate quantities of the gases which they enclose. The samples analyzed were :

From the Newcastle district.

1. Low main Seam from Bewicke Main colliery.
2. Maudlin Seam from do. do.

From the Newcastle-Durham district.

3. Main coal Seam from Morpeth colliery.
4. $\frac{5}{4}$ Seam from do. do.

From the Durham district.

5. Wingate Grange Colliery, $\frac{5}{4}$ Seam, 74 fathoms from surface.
6. Do. do. Low Main Seam, 108 „
7. Do. do. Harvey Seam, 148 „

From a district not named.

8. Upper or Harvey Seam Emily Vil., Woodhouse Close colliery.

The results of the analysis are contained in the following table :

Number of Coal, Sample.	Carbonic Acid.	Marsh Gas.	Oxygen.	Nitrogen.	Cub. cent. of Gas in 100 gram. of Coal.
1	5·55	6·52	2·28	86·55	25·2
2	8·54	26·54	2·95	61·97	30·7
3	20·86	—	4·83	74·31	27·0
4	16·51	trace	5·65	77·84	24·4
5	0·34	85·80	trace	13·86	91·2
6	1·15	84·04	0·19	14·62	238·0
7	0·23	89·61	0·55	9·61	211·2
8	5·31	50·01	0·63	44·05	84·0

The quantity of gas in the Durham coals, 6 and 7, is surprisingly great. These coals are very hard and dense. If their spec. grav. is taken as 1·3 (the spec. gr. of English coals lay, according to Playfair and De la Beche between 1·25 and 1·35), the gases in them must be under a pressure of about three atmospheres.

Samples 5, 6, and 7, are rich in marsh gas, but poor in carbonic acid ; samples 3 and 4 exhibit a converse proportion. *Dingler's Polytech. Journ. ccvi.* 496.

§ 6.—*Electricity and Telegraphs.*

New Batteries.—VORLEE proposes the following modification of Bunsen's battery ; a mixture of 3 parts strong nitric acid, and 1 of sulphuric acid is agitated with powdered potassium dichromate previously moistened with water ; the resulting liquid is used, instead of nitric acid solely, to surround the positive plate of a Bunsen's cell ; the electromotive force of the arrangement is nearly the same (98 per 100) as that of the Bunsen's cell, amalgamated zinc being used in each case ; the internal resistance is about half as much again ; but the action is very much more constant, and nitrous fumes are not evolved to nearly so great an extent as in the ordinary nitric acid battery. *Polytech. Centralblatt*, 1822, 164.

MULLER reports on Bunsen's modification of the nitric acid battery, where chromic acid solution is used instead of nitric. To make a litre of exciting solution, 92 grammes of potassium dichromate are finely pulverized and mixed with 93½ ccs. of concentrated sulphuric acid ; to the resulting paste of chromic acid and acid potassium sulphate 900 ccs. of water is added, whereby the whole is dissolved. When a battery charged with the fluid surrounding the positive pole is worked on short circuit, but little change is noticed in the electromotive force and internal resistance for the first three-quarters of an hour ; but after six hours working, the electromotive force is less than half what it was at first, while the resistance has increased six-fold. When compared with a nitric acid Bunsen's cell, the electromotive force of the new arrangement was found to be slightly greater, the resistance being much the same. *Polytechnisches Journal*, 205, *p.* 104.

KOOSTEN finds that a Grove's battery where the nitric acid is replaced by a solution of potassium permanganate acidulated with $\frac{1}{10}$ part of sulphuric acid, has an electromotive force equal to from 1·9 to 2·2 times that of a Daniell's battery, whilst the Grove's battery had only 1·58 times the electromotive force of a Daniell. Not only is the electromotive force of this new combination greater than that of a Grove's cell, but it is constant, whatever be the strength of the permanganate solution ; the internal resistance is about the same as that of a Bunsen's or Grove's cell. More sulphuric acid than $\frac{1}{10}$ must not be added, otherwise the permanganic acid set free is decomposed with evolution of oxygen. Pure recrystallized permanganate must be employed, as the crude substances contain much chloride. *Polytech. Centralblatt*, 1872, 450.

Preservation of Telegraph Poles in Norway.—MICHEL states that holes are bored some 16 or 18 centimetres deep and sulphate of copper introduced into them, the holes being closed up by resinous plugs. A sort of circulation of sap goes on, whereby the wood becomes gradually impregnated with copper, the introduction of fresh sulphate being repeated several times during two or three years. Fir wood thus prepared does not decay during ten or twelve years in the Norwegian climate (dry and very cold in winter). *Les Mondes.*

§ 7.—*Miscellaneous.*

Artificial Stone.—RANSOME prepares an artificial stone, to which he gives the name *Apoenite*, by compressing in moulds a mixture of infusorial silica *(Kieselguhr)*, silicate of potash or soda, chalk or calcareous substances, sand, alumina, &c. In a short time the whole sets to a hard compact mass, which in time acquires great solidity ; after six weeks a block resists a crushing pressure of 566 kilogrammes per square centimetre ; moreover, neither the cold of a Russian winter nor the heat of India exerts any deleterious influence on the mass. The blocks are also capable of taking a polish or of being painted, and are well adapted to purposes of ornament. *Deutsche Industriezeitung*, 1872, 425.

Cement for Glass and Porcelain.—LIESEGANG recommends that isinglass should be soaked in water till much swelled up, and the softened mass dissolved in alcohol, half as much mastic as of isinglass is then to be dissolved in three times its weight of alcohol, and then the same weight of gum ammoniac added. All the solutions are well mixed and the alcohol evaporated off until the residue forms a strong glue, which must be warmed before use. *Chem. Centralblatt*, 1872, 398.

Substitute for Hydraulic Cement.—MÉNE states that a mixture of 1 part pulverized brick, 2 parts sand, and 1 of lime, well mixed together and then made into a mortar with water, is extensively used in Cuba and elsewhere instead of hydraulic cement. *Revue Hebdomadaire de Chimie Scientifique et Industrielle.*

Hydraulic Cements.—SCHULATSCHENKO concludes, from the results of analyses of various cements and from recent experiments, that the hardening of hydraulic cements (contrary to what is usually supposed) does not depend on the formation of an insoluble basic calcium salt, no such compound being found at all. *Dingler's Polytech. Journal, ccv.* 335.

French Putty.—RUBAN prepares this substance by boiling linseed oil (7 parts) with brown umber (4 parts) for two hours ; 5½ parts of chalk and 11 of white lead are then added, and the whole well mixed. This putty is very durable and adheres well to wood, even though not previously painted. *Bayerisches Industrie & Gewerbe Blatt.*

Resin Oils. — The distilling vessels being charged with resin, and the manholes luted down, heat is applied ; at first water and a light oil (*crude pinoline*) distil over ; this soon ceases, when the recipients are changed and the fire increased ; heavy resin oils then pass over, pitch being left in the retorts. The heavy oils have a dark violet-blue tint, and are hence known as "blue resin oils." This crude oil is boiled for a day with water, the distillate with the steam being collected apart. Next day the water is drawn off, and the residual resin oil saponified with caustic soda ley at 36° Baumé, and the nearly solid product distilled as long as oils pass over ; this "once rectified oil" is then submitted to the same treatment over again, the final distillate being known as "twice-rectified oil." This is used as an adulterant for fish-oils to a large extent, being of much the same consistency, and the peculiar smell of the resin-oils being overpowered by that of the fish-oil ; also for lubricating purposes, shoe-makers' wax, and various compound resinous preparations.

The crude pinoline contains acetic acid, from which calcium acetate is obtainable by saturating the crude distillate with lime, and redistilling the oily portion ; the pitchy residue from this operation, and from the rectification of the heavy oils, is sold along with the original pitch. *Polytech. Centralblatt*, 1872, 1027.

Bleaching of Vegetable Oils.—The bleaching of linseed, poppy-seed, or colza-oil by means of sulphuric acid is connected with the disadvantage that part of the oil is transformed into resin. According to C. Puscher, this can easily be remedied by mixing the acid, before its addition to the oil, with an equal weight of very strong alcohol (96 per cent.). The sulphethylic acid thus obtained mixes freely with the oil. *Dingler's Polytech. Jour. ccv.* 390.

Preparation of Asphalt Paper.—F. PASTOR has devised a simple and effective machine for the production of asphalt paper, which is used as wrapper for silk and other better varieties of textile fabrics. The paper passes between a hollow cylinder heated by steam, and a wedge-shaped box, which contains the asphalt. At the thin end of the box is a slit, the length of which corresponds with the breadth of the asphalt covering that is to be given to the paper. The asphalt must be of such consistency that it will dry as soon as the paper has passed through between cylinder and wedge. With Pastor's machine about sixty yards of paper can be thus varnished per minute. *Dingler's Polytech. Journ., cciii.* 507.

Asphalt Tubes.—Paper of a peculiar quality is soaked in melted asphalt, and then wound upon a cylinder; thereby a tube is obtained of length equal to the breadth of the roll of paper thus used, and of any required thickness. Such pipes can be employed for the conveyance of water, &c.; they have great strength, a tube of half an inch thickness in the walls being capable of resisting fifteen atmospheres' pressure; they are extremely durable, impervious to moisture, and free from many inconveniences to which metal pipes are subject, *e.g.*, rusting; severe frost does not cause disintegration, as is frequently the case with earthenware pipes; their lightness also (one-fifth that of iron) is a great advantage as regards transportability. *Polytech. Centralblatt*, 1872. 786.

Animal Charcoal.—KNAPP states that acetic acid (pyroligneous acid) may be used to dissolve out calcium-carbonate from animal charcoal, which result is effected without causing the solution of calcium-phosphate: if hydrochloric acid (2 per cent. solution) be used, much phosphate is dissolved, and the decolorizing power of the charcoal is injured. Moreover, in case of deficient washing, the calcium-chloride left in the pores of the charcoal becomes partially vitrified by subsequent ignition, and thus glazes the charcoal; whereas acetate of calcium, if not thoroughly washed out, only causes the production of a little infusible calcium-carbonate, which does not materially injure the decolorizing power of the re-burnt charcoal. *Chem. Centralblatt*, 1872, 393.

Purified Animal Charcoal.—GRAEGER states that a charcoal possessed of very high decolorizing powers may be prepared by boiling ordinary animal charcoal with 4 to 5 per cent. of its weight of carbonate of soda dissolved in water, and then treating with sufficient hydrochloric acid to dissolve out the calcium phosphate contained; the charcoal is then to be washed with water till the washings exhibit no acid re-action. 100 parts of ordinary charcoal only yield about 20 of purified material, however. *Bayerisches Industrie & Gewerbe-Blatt, Dec.* 1872.

Action of Charcoal on Organic Nitrogen.—STANFORD finds that when charcoal of various kinds (bone charcoal, wood charcoal, and charcoal from sea-weed) is mixed with nitrogenous organic substances, such as urine, offal, decomposing fish, &c., it acts simply as a drier, and does not act as an oxidising agent, *i. e.* does not cause the conversion of ammonia into nitric acid, although the contrary is usually considered to be the case; after some time, and especially if the mass be artificially dried, a little ammonia may be lost, but this quantity is of no practical importance. Hence the use of charcoal is obviously great as a means of dealing with excretal matters, fish offal, &c., so as to secure the whole of their manurial value in an inoffensive form. *Journal of the Chemical Society*, [2] *xi.* 14.

Tinfoil as a Wall Covering.—DANIELL AND CO. recommend highly the use of tinfoil as a substitute for, and improvement on, paper for covering walls, &c. Colouring and printing can be readily performed on the metallic foil, which has the great advantage of being impervious to damp. *Revue Hebdomadaire de Chimie Scientifique et Industrielle, Nov.* 1872.

Detection of Woody Fibres in Paper.—The usual method for the purpose of identifying the presence of woody matter in paper is to wet the sample with a solution of an aniline salt, which imparts to the wood cellulose a light yellow colour. It is now proposed to substitute for the aniline salt a soluble salt of naphthylamine, which produces a deeper coloration, and is thus capable of indicating a smaller amount of woody fibre in paper. *Dingler's Polytech. Journ. cciii.* 157.

Asbestos for Steam-engines.—DAY recommends the use of asbestos as a substitute for flax and hemp in the packing of stuffing-boxes for steam-engines; it resists the action of moisture at high temperatures, and of friction far better than the vegetable materials. *Les Mondes.*

Indelible Ink.—BOETTGER prepares an ink that does not corrode steel-pens by triturating 3·65 grammes of aniline black with 22 grammes of alcohol, and 60 drops of hydrochloric acid; a porcelain mortar is employed, and the paste thus produced is mixed with 1·82 gramme of gum arabic previously dissolved in 85 grammes of hot water. If this ink be added to an alcoholic solution of shellac (21 grammes of lac to 85 of alcohol), a black product results suitable for colouring leather and wood. *Dingler's Polytech. Journal, January*, 1873.

Vegetable Marking Ink.—BOETTGER states that the juice of the anacardium nut (*Anacardium orientale*) contains an oily constituent which darkens by exposure to air, finally becoming quite black; the colour is discharged neither by acids, alaklies, chlorine, nor cyanide of potassium. The oily product is dissolved out by benzoline (light petroleum distillates); the solution is allowed to evaporate spontaneously by exposure to air, and the thick liquid left is used either for writing or stamping on linen or cotton. The black colour is developed by exposure to air or by moistening with ammonia. *Bayerisches Industrie & Gewerbe-Blatt, Dec.* 1872.

MOIGNO states that the juice of the *coriaria thymifolia*, or ink plant of New Granada, resists most chemical agents better than ordinary ink. When used fresh, the writing is reddish, but it becomes black in a few hours; it does not corrode steel pens, and cannot be removed from paper by sea-water, on which account it was used for all public documents when New Granada was under Spanish dominion, under the name of *chanchi. Les Mondes.*

Pharmaceutical Products from Central Asia.—PALM describes a variety of seaweed, known as *Schörum-dorii*, occurring in the salt lakes of Thibet; when boiled with water this gives a jelly resembling that derived from the Carragheen moss, and containing much iodine. The plant itself contains (when dry) nearly 1 per cent. of iodine combined with bases, a larger amount than that occurring in any other known plant.

A kind of nutgall found in Bucharia and known as *Busgunsch*, contains 43 per cent. of tannin and 3 per cent. of a waxy substance.

Sirauwant is the name of a kind of tuber containing 47 per cent. of starch and a peculiar substance somewhat resembling emetine. *Pharmaceutische Zeitschrift für Russland, No.* 10, 1872.

Australian India Rubber (Coorongite).—A substance has found its way into the market under this name, said to occur in thick layers on the sand on the banks of a deep depression in the soil of Coorong. It is stated to be of undoubted mineral origin (?) and approaches to a hydro-carbon in composition. *Naturforscher*, 1872, *No.* 23.

Mouldiness in Gum Water.—HIRSCHBERG states that the addition of quinine for this purpose, as recommended by Romer, is not effectual; a drop of mustard oil added to ink or to starch paste prevents mouldiness or turning sour.

Gum water that does not become mouldy may be prepared thus: powdered gum arabic is moistened with alcohol and dissolved in the requisite quantity of water; addition of a few drops of sulphuric acid then precipitates calcium sulphate; after this has been removed by subsidence, a perfectly colourless gum water is obtained, even though the original gum were not perfectly white. *Chem. Centralblatt*, 1872, 492.

Tellier's Ice-making Machine.—This machine employs methyl ether as the agent in the production of cold by evaporation, the liquid being obtained by the action of sulphuric acid on methyl alcohol or wood-spirit. The ether is allowed to evaporate in an upright cylinder placed within an enclosed space also containing a series of pipes filled with an aqueous solution of calcium chloride, and thereby cools this solution. The vapour is continually pumped out into another cylinder, where it is again compressed into the liquid form. The cooled calcium chloride solution is made to circulate continuously by means of a rotary pump, passing through the tubes into the chamber where the ice is to be made. The calcium chloride solution is thus reduced in temperature to 10°; but lower temperatures are obtainable. The machine appears to possess many advantages rendering it suitable for technical processes, such as brewing, stearine candle-making, nitro-glycerine manufacture, crystalliza-

tion of salts, and especially the preservation of meat. *Dingler's Polytech. Journal, cciii.* 191.

Chloroform.—BELOHOUBEK finds that no chloroform is obtainable from perfectly pure methylic alcohol or acetic acid on distillation with aqueous solution of bleaching powder, although the contrary is usually stated; chloroform is, however, obtainable in considerable quantity from ordinary purified wood spirit by this process, inasmuch as other bodies besides methylic alcohol are contained; as Lieben has shown that these substances are incapable of forming iodoform, it is probable that no chloroform can be obtained from bodies which do not produce iodoform. *Annalen der Chem. und Pharm. clxv.* 349.

Valuation of Iodine.—WANKLYN estimates commercial samples of iodine by weighing up a known quantity in a corked tube, dissolving in aqueous sulphurous acid, supersaturating with ammonia and precipitating with silver nitrate: if chlorine be present it can be estimated in the ammoniacal filtrate by adding nitric acid which precipitates silver nitrate. Non-volatile matter is estimated in the ordinary way; the difference from 100 may be reckoned as water, a check being obtained by dissolving in carbon disulphide a weighed quantity of iodine contained in a graduated tube, and noting the volume of the water which floats up to the top; two or three hours standing is requisite before reading off, the tube being well corked. The water contained varies from 10 to 20 per cent. *Dingler's Polytech. Journal. ccv.* 57.

LORD BRABAZON'S REPORT ON THE INDUSTRIAL CONDITION OF FRANCE.[1]

IN addition to the general stagnation in all commercial and industrial pursuits, which is the inevitable consequence of war, much has happened during the past year which may have disastrous effects on the commercial future of France. Want of principle and of mutual trust, which are too prevalent in France, and to which thoughtful Frenchmen ascribe their present miseries, must, in time, unless a re-action take place, seriously affect the prosperity of the nation. This will lower wages, and render the position of the artizan worse than it is at present.

Communistic principles have done much to alienate the affections of the workman from the employer, and the French artizan is not clear-sighted enough to perceive that their interests are identical, and that in all large economical questions petty jealousies and rivalries should be put aside. The interest of the trade, not the immediate interest of the individual, should form the study both of the employer and employed; but such a policy is far too long-sighted and calculating for the temperament of the typical French artizan. As a rule, his education is very defective, he has no religion to restrain the evil passions to which all human nature is prone; sceptical of good in his fellow man, he looks upon his employer with distrust, and any advice which comes from that quarter is almost sure to be met with suspicion. Although the late revolt has been suppressed, it is not likely that men who, for the first time in history, actually succeeded in establishing a Government in accordance with these principles, will relax in their exertions because they sustained a single reverse. Can industry flourish where Communism is the dream of the workman, where armed Revolution, not against forms of Government only, but against property and capital, is of periodical occurrence, and where the employer sees in the workman his natural enemy?

To these sad influences between labour and capital we must add the fact that last winter thousands of workmen in Paris received during the first siege, from the Government, and from the Commune during the second siege, higher wages as National Guards than they could ever expect to earn by the quiet prosecution of their trades. These men, now that they are obliged to return to their former occupations, feel with increased acuteness the irksomeness of labour, and long for some opportunity which may give them a pretext of rushing into the streets and of renewing disturbances so profitable to themselves. Again, the increase of taxation will, no doubt, weigh heavily for some time to come on commerce and industry. If, as seems imminent, France, by the abrogation or modification of the Treaty of Commerce with England, should lay increased duties on British goods (which, as regards home produce alone imported into France, amounted in 1860 to £5,249,980, and in 1869 to £11,438,330, thus doubling in value itself within ten years), it is much to be feared that she will find out her mistake when too late, and that this will be but another act of national suicide. [This was written previous to the recent altèration of the treaty.]

The following tables will give some idea of the extent to which British goods were imported under the Commercial Treaty into France, and the loss to which the latter country would be exposed by any rash legislative Act which, for the sake of a transitory increase of income, should divert to more profitable shores this stream of wealth. The immense mercantile marine of Great Britain renders her comparatively independent of any one country, whilst to France the cessation of commercial intercourse with Great Britain would certainly be a most serious blow.

The principal articles imported into France for home consumption in the three years, 1866, 1867, 1868, were raw cotton, silk, wool, wheat, and coals. The value of the imports of cotton in each of the three years was:—

Cotton Imports.	1866.	1867.	1868.
	Francs.	*Francs.*	*Francs.*
From United Kingdom	147,108,866	52,570,070	47,994,788
Turkey	26,092,045	17,555,439	22,537,231
Egypt	35,626,439	19,418,871	24,713,887
British India	23,926,526	26,522,534	51,831,802
United States	153,453,191	98,805,208	122,398,853
Brazil	16,542,393	7,460,996	10,248,750
Total	402,749,460	222,333,118	379,725,311
	£.	£.	£.
	16,109,978	8,893,324	15,189,012

The value of the imports of raw silk in each of the three years was:—

Silk Imports.	1866.	1867.	1868.
	Francs.	*Francs.*	*Francs.*
From United Kingdom	72,121,590	76,305,463	91,227,225
British Mediterranean possessions	11,270,543	11,449,623	2,743,425
Italy	12,831,683	15,745,925	13,970,775
Turkey	26,285,648	21,028,586	21,540,225
British East Indies	3,147,525	9,705,717	8,463,900
China	5,306,242	20,459,876	32,607,375
Total	130,963,231	154,695,190	170,552,925
	£.	£.	£.
	5,238,529	6,187,807	6,822,117

The value of the imports of wool in each of these three years was:—

Wool Imports.	1866.	1867.	1868.
	Francs.	*Francs.*	*Francs.*
From United Kingdom	71,999,368	74,441,779	78,870,480
Turkey	32,952,099	19,444,832	18,517,680
Rio de la Plata	35,552,251	49,189,416	58,867,920
Uruguay	17,489,444	21,384,917	23,316,960
Zollverein	14,327,435	7,183,711	10,394,160
Belgium	14,063,510	13,005,585	19,901,280
Algeria	15,450,376	15,318,703	15,533,520
Total	204,834,483	199,968,943	225,402,000
	£.	£.	£.
	8,193,379	7,998,757	9,016,080

The value of wheat in each of these three years was:—

Wheat Imports.	1866.	1867.	1868.
	Francs.	*Francs.*	*Francs.*
From United Kingdom	2,094,487	12,266,388	7,412,400
Belgium	1,717,895	16,197,336	9,396,000
Russia	1,704,014	37,274,040	46,148,400
Zollverein	5,546,783	37,320,624	39,236,400
Italy	292,703	21,575,304	17,726,400
Turkey	598,650	26,223,228	117,867,600
Total	11,954,532	150,857,820	237,787,200
	£.	£.	£.
	478,181	6,034,312	9,511,488

The value of the imports of coal was:—

Coal Imports.	1866.	1867.	1868.
	Francs.	*Francs.*	*Francs.*
From United Kingdom	32,813,181	36,875,301	33,537,998
Belgium	74,917,076	70,703,900	73,721,354
Zollverein	21,112,822	23,006,569	23,754,803
Total	128,843,079	130,585,770	131,014,155
	£.	£.	£.
	5,153,723	5,223,430	5,224,566

The three principal articles of home manufacture and produce exported from France are silk fabrics, woollen fabrics, and wines.

The value of silk exports in the three years 1866 to 1868 averaged 300,000,000 francs, or £12,000,000, nearly one half of which went to the United Kingdom, while of woollen fabrics the average amount exported in the same period was of the value of 75,000,000 francs, or £3,000,000, rather more than one-fourth going to the United Kingdom. Of wine the exports rose from 234,000,000 francs or £9,360,000 in 1866 to 245,000,000 francs or £9,800,000 in 1868; the value of the quantities shipped to the United Kingdom amounting in 1866 to £1,456,060, in 1867 to £1,497,917, and in 1868 to £1,875,881.

The following table exhibits the real or declared value of the principal articles of British and Irish produce and manufactures imported from the

[1] We propose to give a *précis* of several of these valuable "Reports from Her Majesty's Diplomatic and Consular Agents abroad respecting the Condition of the Industrial Classes in Foreign Countries," which have lately appeared. The present, on account of its importance, we give in full.

United Kingdom into France during each of the two years 1868 and 1869 :—

	1868.	1869.
	£.	£.
Alkali, soda	62,585	62,731
Apparel and haberdashery	89,491	123,079
Beer and ale	24,704	29,312
Caoutchoue, manufactures of	116,065	135,665
Cement	60,570	74,916
Coal, cinders, and culm	872,568	869,137
Corn, wheat	78,893	25,418
Cotton yarn	256,366	242,018
,, piece goods	928,517	987,277
,, hosiery, small wares	176,799	207,800
Drugs and chemicals	96,063	120,197
Earthenware and porcelain	35,473	33,615
Hardware and cutlery	208,368	228,879
Horses	74,174	35,929
Linen yarns	236,579	230,505
,, piece goods	178,259	191,323
Machinery, steam engines	30,883	15,821
,, other sorts	349,929	301,303
Metal—		
Copper, wrought and unwrought	350,623	331,226
Iron, ditto	504,053	704,449
Lead and shot	62,716	57,972
Tin, unwrought	104,048	187,951
,, plates	40,261	43,038
Zinc, wrought and unwrought	33,195	78,316
Naphtha, paraffin oil, &c.	30,595	70,690
Oil, seed	175,100	184,617
Painters' colours	38,968	42,532
Silk yarn	93,551	72,498
,, thrown	342,936	346,442
,, manufactures	92,408	113,630
Spirits, British	1,833	1,847
Telegraph wire and apparatus	467	534,432
Wool, sheep and lambs'	349,664	380,292
Woollen yarn	893,561	705,573
,, manufactures, cloths, &c.	356 501	551,371
,, worsted stuffs	1,187,425	1,137,576
,, flannels and carpets	159,631	156,819
,, of other sorts	204,751	137,898
All other articles	1,751,943	1,484,230
Total £	10,652,734	11,438,330

The population of France, by the last census of May 15, 1866, amounted to 38,067,094, minus the army and navy stationed out of France, which were estimated at about 125,000, but from this we must now deduct the loss she has sustained in population from the annexation by Germany of the two provinces of Alsace and Lorraine, which may be calculated as entailing a loss to France of about 1,500,000 souls: add to this her loss in the late war, and we may say that last year the population of France was diminished by about 2,000,000.

The increase of population in France within the last century and a-half has been comparatively less than in any other State of Western Europe.

The following are taken from the Census Returns:

Year.	Population.
1700	19,669,320
1762	21,769,163
1784	24,800,000
1801	27,349,003
1821	30,461,875
1841	34,230,178
1851	35,783,170
1856	36,039,364
1861	37,386,161
1866	38,067,094

In 1845 the annual increase was 200,000 on 35,000,000 inhabitants. Just before the outbreak of the war it had diminished to 130,000 on 38,000,000.

If the present rate of increase of population in England and France were to continue for the next forty years, England would have doubled her population, whilst France would have but 45,000,000 inhabitants.

There are 9,000,000 families in France, 1,000,000 of which are in easy circumstances. Of the 8,000,000 belonging to the industrial and working classes, 3,000,000 are inhabitants of towns; whereas the town population of England is computed at four-fifths of the whole, in France it is about two-fifths. Land is very equally distributed among the bulk of the population, and the same is the case with personal property. In 1846 the population of France was distributed as follows:—Rural, 75·58 per cent.; urban, 24·42 per cent. In 1861 the proportion was, rural, 71·14 per cent.; urban, 28 86 per cent.

The decrease of the rural and increase of town population has continued since 1861 at an augmented rate.

The amount of general education of the French people may be judged to some extent from the military statistics. The number of conscripts unable to read amounts to 30 out of every 100 for the whole of France. The degree of education, however, varies greatly in different parts of the country, instruction being far more general in the eastern and northern than in the southern districts. Among the 89 Departments there are 14 in which out of every 100 conscripts from 90 to 96 can read. The Departments so distinguished are the Doubs, Haute-Marne, Meuse, Bas-Rhin, Meurthe, Jura, Moselle, Vosges, Aube, Seine, Haut-Rhin, Haute-Saône, Côte d'Or, and Hautes-Alpes. The next are the Marne, Ardennes, Seine et Vise, Rhone, Seine et Marne, Manche, Oise, Calvados, Haute-Savoie, Yonne, Euse et Loire, Isère, Orne, Hautes-Pyrénées, or 14 Departments in which from 80 to 90 out of 100 conscripts can read. Those which show from 70 to 79 per cent. who can read are the Aire, Somme, Aisne, Savoy, Euse, Herault, Gard, Drôme, Basses-Alpes, Charente-Inférieure, Bouches-du-Rhone, Deux-Sevres, Loiret, Aveyron, Pas-de-Calais and Gironde. The Departments with from 60 to 69 per cent. who can read, are Cantal, Seine-Inférieure, Vaucluse, Lozère, Gers, Saône et Loire, Aude, Basses-Pyrenées, Lot et Garonne, Nord, Haute-Garonne, Var, Charente, Maine et Loire, Corsica, Loir-et-Cher, Mayenne, Sarthe, and Creuse. Twelve Departments, namely, the Lot, Loire-Inférieure, Ardeche, Indre-et-Loire, Ille-et-Vilaine, Puy de Dôme, Tarn-et-Garonne, Alpes Maritimes, Vendée, Tarn, Pyrenées Orientales, and Vienne, show from 50 to 58 per cent. not quite illiterate. The list closes with the Nievre, Haute-Loire, Landes, Arége, Dordogne, Cher, Morbihan, Indre, Côtes-du-Nord, Corrèze, Finistère, Haute-Vienne and Allier.

The following table may be of some use in forming an opinion with regard to the morality of the French nation in 1865 :—

	Legitimate Births.	Illegitimate Births.	Proportion of Legitimate to one Illegitimate.
Department of the Seine	46,062	15,985	2·88
Town Population	230,224	29,699	7·76
Country Population	653,694	30,247	21·61
Total	929,980	75,931	..

The proportion of legitimate births to illegitimate was almost precisely the same in the five preceding years, being at the rate of 21½ to 1 for the country population, of 7¾ to 1 for the town, and of not quite 3 to 1 for the Department of the Seine.

There is no country in Europe, with the exception of Russia, which possesses so varied a climate as France. Whilst in the north we meet with a climate not dissimilar to our own, we have only to go to the shores of the Mediterranean to find a country more southern, and even tropical, in its aspect than many situated far nearer the equator.

How vast a difference exists in climate between the Departments bordering on the frontiers of Luxembourg and Germany and those at the foot of the Pyrenees, between the rugged, wild districts of Bretagne and those of tropical Roussillon, between the mountains of the east, the centre, and the south, differing so essentially in their geological character, the one calcareous, the others volcanic and granitic.

France may be said to possess five climates :—

1. The north-eastern.
2. The north-western.
3. The south western.
4. The south-eastern.
5. The southern.

1. The north-eastern climate embraces the region between the Rhine, the Côte d'Or, the source of the Saône, and a line drawn from Mezières to Auxerre.

2. The north-western prevails throughout that portion of France, comprised between the Channel, the Loire, the Saône, Mezières, Auxerre, and the Belgian frontier.

3. The south-western climate is that which prevails between the Loire, the Ocean, and the Pyrenees.

4. The south-eastern is that between the valley of the Saône and the Rhône, from Dijon and Besançon to Viviers, and embraces a portion of the Alps.

5. The southern or Mediterranean climate is to be met with within a kind of triangle, of which Viviers, Marseilles, and Montpellier are the angles.

The first two climates are somewhat cold; the first, being continental, is dry, like that of Germany. The average temperature is about 49° Fahrenheit. The winters are more rigorous than in the rest of France. The second, being a maritime climate, is wet and foggy, like that of England The average temperature is 51° Fahrenheit, and the difference between that of summer and winter is much less than in the preceding region.

The two following climates, 3 and 4, are much more temperate, but present the same difference in consequence of their continental and maritime situations. The average temperature of the south-western climate is 55° Fahrenheit; that of the south-eastern 52° Fahrenheit. The difference between winter and summer is much greater in the south-eastern than in the south-western district, owing to the proximity of the ocean to the latter.

Lastly, in the 5th region the average temperature is 59° Fahrenheit. The summers are much hotter than in the rest of France. The winds which prevail in this district are very violent, and hurtful to both health and vegetation :—

1. The "mistral," or cold north-north-west wind.
2. The "sirocco," or burning southern winds fresh from the African deserts.
3. The east or Alpine wind, called the "bise."

The following table gives the average temperature and number of rainy days in the principal towns of France :—

Towns.	Average Temperature. Fahrenheit.	Number of Rainy Days.
Marseilles	57	55
Bordeaux	56	150
Toulouse	55	118
Nantes	54	122
Lyons	52	(?)
Rouen	52	121
Paris	51	148
Bourges	49	101
Lille	48	169
Dunkirk	48	126

It will be seen from the above that Marseilles enjoys both the greatest heat and the smallest rainfall, whilst Lille has the largest share of rain, and Dunkirk the lowest temperature.

The variety of climate having naturally a vast influence on the question of health throughout France, and occasioning a marked difference in the habits and customs of the inhabitants, in their dwellings, in their food and clothing, renders it essential for the sake of accuracy to divide the country into six divisions, each composed of 14 to 15 Departments, and from about 19,000,000 to 22,000,000 acres, as will be later explained.

Before, however, proceeding to local details, answers shall, as far as possible, be given to the questions contained in Lord Clarendon's Circular.

As the working population of all countries may be divided into two sections, the Agricultural and the Industrial, and as the condition of the former is not subject to as many changes and variations as the latter, it will be more convenient to give separately a general description of the agricultural class throughout France, before proceeding to consider the questions regarding the artizan, for whose more especial benefit it would seem that this Circular was issued.

Agricultural Labourers.

Agricultural labourers are divided into two categories: those engagep by the year and who live on the farm, and those who work by the day. Farm labourers who live in the farm buildings receive, in addition to food and lodging, wages partly paid in money and partly in kind. The average amount of money wages earned by farm labourers is 145 francs a-year (5*l.* 16*s.*)

In some Departments, such as l'Aisne, l'Aube, les Bouches du Rhône, and La Côte d'Or, labourers earn over 200 francs in the year (8*l.*) In others, such as l'Ariège, la Corrèze, les Côtes du Nord, la Finistère, La Haute-Garonne, they do not receive more than 100 fr. (4*l.*) The additional amount of wages received in kind throughout France is calculated to be about 26 fr. (1*l.* 0*s.* 9½*d.*); but there is a much greater difference in the amount paid in kind than in money. In the Departments Bouches du Rhône, Gard, and Gironde, it is not customary to pay in kind. In some this description of payment does not amount to more than 10 francs (8*s.*); in some it surpasses in value the amount of the money payment (Aisne, Aude, Hérault).

By adding together both descriptions of payment it will be found that the average amount of wages received by a farm labourer in France is 171 francs (6*l.* 16*s.* 9½*d.*) a-year. If to this be added the value of food consumed by the labourer, which may be calculated at about 50 cents (4½*d.*) a-day, it will be found that the maintenance of a farm labourer costs his employer, on an average, about 354 francs per annum (14*l.* 3*s.* 2⅜*d.*)

The wages of day labourers vary, according as they are fed or not. In order to facilitate comparison we will only take into consideration the day labourer, who is not fed by his employer. The following table, showing the average amount of wages paid to agricultural labourers in the different Departments, and which appears in a Report presented to the Emperor Napoleon III. by the Minister of the Interior in 1858 will be of interest, as wages in the agricultural districts have not altered much since that period:—

Names.	*Fr.*	*c.*	*s.*	*d.*
Ain	1	75	1	4½
Aisne	1	75	1	4½
Allier	1	60	1	3⅜
Alpes Basses	1	90	1	6¾
Alpes Hautes	1	65	1	3⅝
Ardêche	1	60	1	3⅜
Ardennes	1	87	1	5½
Ariège	1	25	1	0
Aube	2	0	1	7½
Aude	1	40	1	1½
Aveyron	1	50	1	2⅝
Bouches du Rhône	2	50	2	0
Calvados	1	75	1	4½
Cantal	1	55	1	2⅝
Charente	1	60	1	3⅜
Charente Inférieure	2	25	1	9⅝
Cher	1	50	1	2⅝
Corrèze	1	50	1	2⅝
Côte d'Or	2	0	1	7½
Côtes du Nord	1	13	0	10⅝
Creuse	1	25	1	0
Dordogne	1	38	1	7⅜
Doubs	2	35	1	10⅛
Drôme	2	0	1	7½
Eure	2	25	1	9⅝
Eure et Loir	1	50	1	2⅝
Finistère	1	20	0	11⅝
Gard	1	75	1	4½
Garonne	1	30	1	0⅝
Gers	1	40	1	1½
Gironde	2	0	1	7½
Hérault	2	50	2	0
Ille et Vilaine	1	50	1	2⅝
Indre	1	63	1	3½
Indre et Loire	1	50	1	2⅝
Isère	1	85	1	5⅞
Jura	2	0	1	7½
Landes	1	50	1	2⅝
Loir et Cher	1	85	1	5⅞
Loire	2	0	1	7½
Loiret	2	0	1	7½
Lot	1	75	1	4½
Lot et Garonne	1	75	1	4½
Lozère	1	50	1	2⅝
Maine et Loire	1	75	1	4½
Manche	1	50	1	2⅝
Marne	2	20	1	9½
Marne Haute	2	0	1	7½
Mayenne	1	50	1	2⅝
Meurthe	1	75	1	4½
Meuse	1	70	1	4⅜
Morbihan	1	15	0	11
Moselle	1	25	1	0
Nièvre	1	45	1	2
Nord	1	75	1	4½
Oise	1	50	1	2⅝
Orne	2	0	1	7½
Pas de Calais	1	40	1	1½
Puy de Dôme	1	55	1	3
Pyrenées Basses	1	25	1	0
Pyrenées Hautes	1	20	0	11½
Pyrenées Orientales	1	50	1	2⅝
Rhône	2	5	1	7⅞
Saône Haute	1	65	1	4
Saône et Loire	1	75	1	5
Sarthe	1	50	1	2⅝
Seine	2	50	2	0
Seine et Marne	1	50	1	2⅝
Seine et Oise	2	0	1	7½
Seine Inférieure	2	0	1	7½
Sevres (Deux)	1	80	1	5½
Somme	1	50	1	2⅝
Tarn	1	25	1	0
Tarn et Garonne	1	20	0	11½
Var	1	75	1	4½
Vaucluse	2	5	1	7⅞
Vendée	1	50	1	2⅝
Vienne	2	0	1	7½
Loire, Haute	1	60	1	3⅜
Vosges	1	75	1	4½
Yonne	1	88	1	6

From the above table it will be seen that the average daily pay of a day labourer in France is 1 fr. 75 c. (1*s.* 4½*d.*) The highest is 2 fr. 50 c. (2*s.*) in the Department of the Seine, and the lowest 1 fr. 13 c. (10⅞*d.*) in the Côtes du Nord. According to the "Statistique Agricole Officielle" the daily pay of a woman in the agricultural districts is 85 c. (8½*d.*), and that of children 63 c. (6¼*d.*) The same document shows that the male agricultural labourer works, on an average, 200 days in the year, women 120, and children 80.

If the above figures be correct the day labourer earns on an average, 350 fr. (£14), a woman 102 fr. (£4 1*s.* 7⅛*d.*), and a child 50 f. (£2). The same publication gives the following calculations on the annual expenses of day labourers, single and married:—

Average expenditure of a single man:—

	Francs.	£	*s.*	*d.*
Lodging	27	1	1	7½
Food	230	9	4	0
Clothing	45	1	16	0
Total	302	12	1	7½

Deducting this from the amount which it was calculated he earned in the year (350 fr.—302 fr.), only 48 fr. or 1*l.* 18*s.* 4¾*d.* remains for other expenses, or for investment in the savings-bank.

Average expenditure of a married day labourer's family, consisting of father, mother, and three children:—

Items of Expenditure.	Fr.	c.	£	*s.*	*d.*
Lodging	42	0	1	13	7½
Bread	235	0	9	8	0
Vegetables	36	0	1	8	9½
Meat	42	0	1	13	7½
Milk	24	0	0	19	2⅝
Wine, beer, and cider	34	0	1	7	2⅝
Salt	7	50	0	6	0
Clothing	91	0	3	12	9½
Firing	32	0	1	5	7½
Taxes	5	45	0	4	4½
Other expenses	32	0	1	5	7½
Total	581	45	23	5	1½

The above is, of course, calculated to meet the requirements of a French, and not of an English, labouring man.

For a family consisting, as we have said, of five persons, to be able to afford the above expenses, they must all work, and even then the united wages leave but a small margin.

	Fr.	c.	£	*s.*	*d.*
Man's wages	350	0	14	0	0
Woman's ditto	102	0	4	1	7⅛
3 children, at 50 fr. a year	150	0	6	0	0
Total	602	0	24	1	7⅛

The married workman is, therefore, according to this calculation, and under very favourable circumstances, still worse off than his single neighbour; for whilst the latter may, if he is economical, lay by about 48 francs, the other will have but a balance of 21 francs at the end of the year.

But it must be here remarked that, amongst agricultural labourers in France, there are a certain number who supplement their resources by the prosecution of an accessory industry, such as weaving, wood-cutting, sawing, wooden-shoe making, cask-making, and building. Such an accessory industry may increase a single man's wages by about 190 francs a year (7*l.* 12*s.*); but it is probable that those who carry on a trade in addition to their agricultural labour, cannot work as many days in the year at agriculture, and consequently earn less than the purely agricultural labourer. It is calculated that about eight per cent. of the agricultural labourers are engaged in some trade. For the sake of comparison, it may be interesting to insert here the average wages of agricultural labourers throughout Europe in 1850, since which period it has been calculated that wages have risen from about fifteen to thirty per cent.

Countries.	Fr.	c.	*s.*	*d.*
England	1	66	1	4⅞
Belgium	1	20	0	11⅝
Prussia	0	95	0	9½
Bavaria	0	80	0	7⅞
Baden	0	77	0	7⅝
Spain	2	0	1	7⅞
Holland	1	25	1	0
Luxembourg	1	20	0	11⅝
Denmark	0	55	0	5⅜
Schleswig-Holstein	0	75	0	7⅜
Sweden	0	92	0	9⅛
Mecklenburg	0	93	0	9⅛
Hanover	0	62	0	5⅞
Saxony	0	62	0	5⅞
Wurtemburg	1	15	0	11⅜
Hesse	0	75	0	7⅜
Austria	1	32	1	0⅝
Italy	0	87	0	8½

In order to form a just appreciation of the material condition of a working-man, it is not sufficient to have a knowledge of the average amount of wages he earns in the year; but we must also know how much must be deducted from this sum to defray the necessary expenses of lodging.

By the law of the 13th April, 1850, a Special Permanent Committee was appointed for the purpose of examining unhealthy lodgings, and of seeing that the necessary sanitary improvements are made. If the proprietors refuse to undertake the work, they can be prosecuted by law.

The following table will show the amount of rent paid by an artizan's family in 1844, and by an agricultural labourer's family in 1852. The first column is extracted from the Agricultural Report of 1852, published in 1859-60 by the Minister of Agriculture. The second from the Reports of the Mayors of the Departmental chief towns in 1844. Although there is an interval of eight years between the date of these two Reports, there does not appear to be any objection to employing them for the sake of comparison, as these years, according to the most trustworthy authorities, formed a period of complete stagnation in the price of lodging, both in town and country. As no official Reports on the subject have been published since 1860, it is impossible to state, with any degree of accuracy, the present price of lodging, either in town or country; but we may safely infer that the rise in rent has more than kept pace, at all events in the towns, with the rise in wages, and that, therefore, it will be no exaggeration to say that, since the date of these Reports, rent has risen at least thirty per cent.

TABLE of the Average Rent paid by Agricultural Labourers in 1852, and Artizans in the Chief Departmental Towns in 1844.

Departments.	Agricultural Labourers. 1852.			Artizans. 1844.		
	Frs.	£ *s.*	*d.*	*Frs.*	£ *s.*	*d.*
Ain	43	1 14	5	87	3 9	8
Aisne	51	2 0	10	104	4 3	3
Allier	41	1 12	10	75	3 0	0
Alpes Basses	36	1 8	10	54	2 3	4
Alpes Hautes	38	1 10	5	40	1 12	0
Ardèche	42	1 13	6	52	2 1	8
Ardennes	56	2 4	9	106	4 5	0
Ariège	39	1 11	3	75	3 0	0
Aube	56	2 4	10	78	3 2	6
Aude	41	1 12	10	62	2 9	7
Aveyron	29	1 3	3	47	1 17	8
Bouches du Rhone	62	2 9	6	87	3 9	8
Calvados	41	1 12	9	87	3 9	8
Cantal	26	1 0	10	50	2 0	0
Charente	40	1 12	0	77	3 1	8
Charente Inférieure	48	1 18	6	90	3 12	0
Cher	50	2 0	0	88	3 10	6
Corréze	27	1 1	8	67	2 13	8
Côte d'Or	49	1 19	2	112	4 9	8
Côtes du Nord	22	0 17	7	51	2 0	9½
Creuse	34	1 7	3	62	2 9	8
Dordogne	34	1 7	3	86	3 8	10
Doubs	46	1 16	10	77	3 1	8
Drôme	40	1 12	0	85	3 8	0
Eure	51	2 0	10	67	2 13	7
Eure et Loire	49	1 19	3	72	2 17	8
Finistère	26	1 0	10	64	2 11	3
Gard	50	2 0	0	72	2 17	9
Garonne Hautes	37	1 9	8	82	3 5	8
Gers	36	1 8	10	62	2 9	8
Gironde	40	1 12	0	90	3 12	0
Hérault	49	1 19	3	79	3 3	4
Ille et Vilaine	28	1 2	6	57	2 5	8
Indre	43	1 14	6	57	2 5	8
Indre et Loire	41	1 12	10	78	3 2	6
Isère	45	1 16	0	89	3 11	3
Jura	43	1 14	6	76	3 0	10
Landes	36	1 8	10	62	2 9	8
Loir-et-cher	55	2 4	0	65	2 12	0
Loire	44	1 15	3	88	3 10	6
Loire, Haute	27	1 1	7	43	1 14	5
Loire, Inférieure	29	1 3	3	67	2 13	8
Loiret	54	2 3	4	65	2 12	0
Lot	33	1 6	6	58	2 6	6
Lot et Garonne	38	1 10	6	77	3 1	8
Lozère	25	1 0	0	58	2 6	6
Maine et Loire	40	1 12	0	77	3 1	8
Manche	27	1 1	8	78	3 2	8
Marne	60	2 8	0	78	3 2	6
Marne, Haute	48	1 18	6	75	3 0	0
Mayenne	43	1 14	6	75	3 0	0
Meurthe	53	2 2	6	74	2 19	2
Meuse	51	2 0	10	92	3 13	8
Morbihan	23	0 18	6	35	1 8	0
Moselle	51	2 0	10	92	3 13	8
Niévre	41	1 12	10	70	2 16	0
Nord	53	2 2	6	89	3 11	4
Oise	51	2 0	10	79	3 3	4
Orne	38	1 10	6	51	2 0	10
Pas de Calais	44	1 15	3	71	2 16	10
Puy de Dôme	27	1 1	8	66	2 12	10
Pyrenées, Hautes	37	1 9	8	50	2 0	0
Pyrenées, Basses	32	1 5	10	81	3 4	10
Pyrenées, Orientales	55	2 4	2	87	3 10	0
Rhone	61	2 8	10	110	4 8	0
Saône, Haute	42	1 13	8	90	3 12	0
Saône et Loire	44	1 15	3	92	3 13	8
Sarthe	44	1 15	3	57	2 6	0
Seine	100	4 0	0	117	4 13	7
Seine et Marne	65	2 12	0	10	3 4	0
Seine et Oise	63	2 13	6	76	3 0	10
Seine Inférieure	61	2 8	10	102	4 1	8
Sevres Deux	39	1 11	4	74	2 19	2
Somme	36	1 8	10	77	3 1	8
Tarn	31	1 4	10	55	2 4	0
Tarn et Garonne	30	1 4	0	57	2 5	10
Var	47	1 17	8	67	2 13	8
Vaucluse	66	2 12	10	72	2 17	8
Vendée	36	1 8	10	65	2 12	0
Vienne, Haute	32	1 5	8	73	2 18	4
Vienne	41	1 12	10	80	3 4	0
Vosges	46	1 16	10	78	3 2	6
Yonne	56	2 4	9	92	3 13	8
Average	44	1 15	2	75	3 0	0

The above figures show that the annual rent paid by a family of agricultural labourers may be estimated at 44 fr. (1*l.* 15*s.* 2½*d.*), and that of the artizans in the chief Departmental towns at 75 fr. (3*l.*) The difference is therefore in the ratio of about 3 to 5: thus, whilst at about the same period town workmen were earning wages 53·52 per cent. higher than agricultural labourers (2 fr. 18 c., and 1 fr. 42 c.), these latter were paying 70.45 per cent. less rent.

The price of workmen's lodgings does not always exclusively depend on the density of the population of the towns where the workmen reside. It principally depends on the amount of accommodation which is provided for them. It sometimes happens that even in the most crowded districts in the centres of industry the rent of workmen's lodgings may be very moderate, if, as at Mulhouse, the principal manufacturers have built what are called "cités," or a collection of houses for their workmen, or if, as at Amiens, speculation has erected in the Faubourgs a large number of houses for the use of the working classes. It must not, therefore, be a matter of astonishment if, in the preceding table, the highest figures are not always to be found in those Departments which are the most devoted to industry, or where the population is most dense.

As the question of the amount of produce to be obtained from the soil is one of vital importance to the working classes, as affecting the price of all articles of consumption, it may not be irrelevant to give here the substance of a speech made by Professor Georges Ville at Sorbonne, on the 14th of March of last year, in which he traced the cause of the increased and daily increasing price of living in France to the insufficiency of the production of the soil. He stated that the production of France, in grain and cattle, did not suffice for the population, and that there was an annually increasing deficit.

In the period between 1827 and 1836 the value of this deficit was 23,000,000 fr.; in 1837 to 1846 it rose to 25,000,000 fr.; in the following decennial periods (1847-1856 and 1857-1866) it varied from 49,000,000 fr. to 79,000,000 fr.; and in 1868 it reached 200,000,000 fr. (8,000,000*l.*)

This deficit in the amount of production, the enormous military force, the accumulation of the population in towns to the detriment of the country, all led to the same conclusion, and explained the high price of provisions, which, he stated, had been on the increase for the last forty years

In addition, the accumulation of workmen in the large towns had raised the importance of these centres of consumption; the food with which they were supplied was of the best quality; the price of trans-

port, and the per-centage raised by those through whose hands it passed, had all exercised a marked influence in raising prices. It was also a well-known fact that the prices quoted in the large markets re-acted on those in the districts of production: thus the dearness of living in the large towns was little by little extended over the whole of France.

M. Ville asserted that the average return of wheat was 14 hectolitres the hectare (4 quarters 6·517 bushels per 2 acres 1 rod 35·383 poles), and that it had been satisfactorily proved by experiments that it was quite practicable, by a judicious use of artificial manure, to obtain 30 hectolitres per hectare (10 quarters 2·536 bushels per 2 acres 1 rod 35·383 poles).

The question was therefore simply one of calculation, whether it was more profitable to raise 14 hectolitres for 20 fr. (4 quarters 6·517 bushels for 16*s.*), or to sell 30 hectolitres at a reduced price, say 16 fr. (10 quarters 2·536 bushels for 12*s.* 9½*d.*)

The answer is of the simplest. If the productive power of the soil is 14 hectolitres, at 20 fr. the hectolitre, the amount realized will be 280 fr. (11*l.* 4*s.*) If, however, 30 hectolitres are obtained from the same amount of land, and the price reduced to 16 fr. the hectolitre, the amount realized will be 480 fr. (19*l.* 4*s.*), which may be increased to 520 fr. (20*l.* 16*s.*) by the sale of the increased amount of straw.

Here the same amount of soil returns its owner an income of 520 fr., as opposed to 280 fr., an increase of 230 fr. (9*l.* 4*s.*) obtained simply by the use of chemical manure.[1]

Purchase Power of Money.

Before a satisfactory reply can be given to this question, considerations of a most intricate nature must be taken into account. Not only must we consider whether such and such an article does not suffer a variation in price before it reaches the consumer, in some particular districts or towns to which it is not subject in others. For instance, octroi duties, unknown in England, enhance the price of all articles of consumption in the large French towns. Again, the purchasing power of money is in direct proportion to the prudential qualities of its possessor. For instance, let the same sum of money be given to two men, and let them spend it in the same town and under the same advantages, but let one be a spendthrift and the other a sensible, calculating man of business. Will the value obtained be the same in both cases? It is more likely that the articles purchased will represent a gain of say 20 per cent. on the one side, and a loss of about the same amount on the other. If this is the case between the natives of the same country, how much more will it be the case when one is a foreigner and the other a native? It must be evident to those who are conversant with foreign life and habits, that quite independently of the real and actual cost of things in a foreign country, the purchasing power of money is dependent, in a great measure, upon the possession of a thorough knowledge not only of the language, but of the local habits and modes of life. But even this is not sufficient. To obtain from his money its full purchasing power, the foreigner must be above all prejudice, and possess a power of adaptation to the customs of the country which is scarcely to be met with amongst the educated classes, and which it would be Utopian to expect from the average working man.

In France especially, owing to the diversity of its physical character, its extent, and the variety of its natural produce, it would always be a difficult task to lay down any general rules upon which a calculation of the kind might be fairly based; but now that she is still reeling from the effects of the gigantic struggle in which she has been engaged—a struggle so disastrous to her economical organization—it is impossible to arrive at data sufficiently reliable to enable a subject, so intricate in its bearings, and so replete with difficulty, to be answered with any degree of precision. It is possible that in the country the purchase power of a franc may represent that of a shilling in England; but in Paris and in the large towns of France, a man may be considered a good manager indeed if he obtain the same value for his money as he does in England.

Food.

The food of the French workman is, as a general rule, substantially inferior to that to which the Englishman is accustomed. Many a French factory-hand never has anything better for his breakfast than a large slice of common sour bread, rubbed over with an onion so as to give it a flavour. For dinner, some soup, potatoes, or carrots, and sometimes a small piece of pork, which costs about 10*d.* a pound; and for their last meal they eat the meat of which their soup was composed. With this frugal fare some drink only water, others half a bottle of cider, beer, or wine. Bread, vegetables, and fruit are generally to be obtained in France both cheap and good, but meat is bad and dear.

The following is the present price of food in a "cuisine ouvrière," frequented by none but factory-hands, at Rouen:—

Bill of Fare.

	d.	
A dish of meat and vegetables	3	5½*d.* a meal.
Bread, *ad libitum*	1½	
¼ litre or ⅓ of a pint of "cidre coupé," or cider and water	1	
⅓ of a pint of pure cider	1½	
A basin of soup	1½	

In the north of France an Englishman need make no difference in the amount or the nature of the diet to which he is accustomed. As he approaches, however, the southern districts he should diminish the amount of animal food and substitute for it bread and vegetables.

Bread is an article which is always to be got good in France, and Frenchmen consume it in much larger quantities than we do. It forms the "pièce de résistance" at every French workman's meal, and all other articles of food are regarded but as accessories to what in France is literally the "staff of life." The French have always been renowned for their culinary skill. It is a talent peculiar to the whole nation. The very poorest classes possess it. A French man or woman will manufacture a palatable meal out of the very coarsest and what, to our ideas, may appear even repulsive materials. The "soupe" which is to be met with on every French workman's table is infinitely preferable to the concoction of hot water, pepper, and gravy which the richest millionnaire in England is obliged to put up with if he has to dine at an ordinary English provincial hotel, or even at many an establishment in the metropolis calling itself first-class. And yet it would be injudicious, sometimes, to look too closely into the composition of the French dish. The result of this is, that a French workman can live, and even luxuriously, where an Englishman would starve. As regards beverages, beer and wine are good, wholesome, and cheap. Within the last few years the consumption of beer has increased enormously amongst all classes. Formerly it was almost unknown in France, now it is the common restaurant beverage of the Parisian middle class. The workmen, however, still cling to their wine, the beverage commonly consumed by all classes at home. The beer principally drunk is the light Strasburg, which still bears its German name of "bock," though it is of a much milder nature than the original.

The French are very much addicted to the use of the deleterious spirit called "absinthe," which has a most injurious effect on their health. The Englishman is at all times too prone to indulge freely in drink, but if he has any regard for his health, he will be careful to avoid dram-drinking (the "petit verre," composed of all sorts of noxious spirits); for, in addition to the adulterated character of these spirituous liquors, which are sold to the working-classes at a cheap rate, the dry climate of France will not permit men to take with impunity the amount of spirit which they could perhaps drink in England without any positively injurious effect.

According to Dr. Cenveilhier the population of France is not sufficiently well nourished. He calculates the daily consumption of alimentary matter by a strong, healthy man to be, at present, from 46 to 49 oz., viz., 28 oz. water, 14 oz. carbon, and 7 oz. azote or nitrogen.

In order, he says, that the matter eliminated should be regularly replaced, there ought to be an excess of carbon and nitrogen.

A healthy man ought, therefore, to consume daily 31 oz. of dry food, or 6 cwts. 1 qr. 14·297 lbs. annually.

The rations of the French soldier have been fixed upon this calculation.

It is, however, proved that the average daily consumption of the whole population is only 4 cwts. 1 qr. 9·017 lbs., instead of 6 cwts. 1 qr. 14·297 lbs. annually; but, if the number of children under five years of age be deducted, the consumption will be 4 cwts. 2 qrs. 3·63 lbs., a difference of from 1 cwt. 3 qrs. 2·416 lbs. to 1 cwt. 3 qrs. 13·439 lbs., or 29 per cent.

This consumption, which corresponds to 44 gallons of wheat, 22 gallons of barley or rye, 75·018 lbs. of meat, and 80·377 lbs. of potatoes is, according to the Doctor, much above the average of the last century, but is, he considers, still insufficient.

This must be very much below the average wants of a large portion of the population, because it must be borne in mind that the general consumption is relatively greater among the upper classes and in towns, than among the poorer classes and in the country.

As regards the consumption of wheat alone, the average is stated to have been 33 gallons per man in 1821, and 63 gallons per man in 1862.

The consumption of meat per head since the year 1812 is shown by the following table, in lbs.:—

Years.	Sheep, Pigs, Goats.	Oxen.	Cows, Calves.	Total.
1812	4·409	2·205	15·432	22·046
1830	11·023	4·409	17·637	33·069
1840	17·637	4·409	17·637	39·683
1852	17·637	4·409	24·251	46·297
1862	22·046	6·614	24·251	52·711

Taking into consideration the increase of population, the consumption per head for 1871 would be over 72 lbs.

In 1862, 1,900,000,000 lbs. of meat were consumed in France (reckoning the kilogramme at 2 lbs. English); 48 per cent. were oxen, 40 per cent. pigs, 12 per cent. sheep and goats; in all 16,000,000 of animals were slaughtered.

The following table will show the price of provisions in France during a period of thirty-two years:—

Average periods of Years.	Half a kilo. = 1 1/10 of an English lb.				Ordinary-sized Bird.			Half-kilo. Butter.	1 dozen Eggs.	2½ bushels Potatoes.
	Beef.	Mutton.	Veal.	Pork.	Chicken.	Goose.	Turkey.			
	Cents.	*Cents.*	*Cents.*	*Cents.*	*F. c.*	*F. c.*	*F. c.*	*F. c.*	*F. c.*	*F. c.*
1824-1833	36	38	38	43	0 82	2 49	3 62	0 71	0 41	2 87
1834-1843	39	41	40	46	0 88	2 63	3 92	0 75	0 43	3 17
1844-1853	41	44	43	50	0 98	2 88	4 20	0 80	0 47	4 28
1854	47	51	49	61	1 20	3 37	5 1	0 90	0 54	6 15
1855	52	56	54	66	1 37	3 66	5 31	0 98	0 58	6 73

[1] *Weights and Measures.*

The Metre	3·28 feet or 39·37 inches.
Kilometre	1,093 yards, or nearly 5 furlongs, or ⅝ of a mile.
Hectare	2·47 acres.
Kilogramme	2,205 lbs. avoirdupois.
Litre	1·76 Imperial pints.
Hectolitre, liquid	22 gallons.
,, dry	2·75 Imperial bushels.

½ a kilogramme is equal to a pound.

Annual increase per cent.

From	F. c.	F. c.	F. c.	F. c.	F. c.	F. c.	F. c.	F. c.	F. c.	F. c.
1824-1833 to 1834-1843	0 83	0 79	0 53	0 70	0 73	0 56	0 83	0 56	0 49	1 5
1834-1843 to 1844-1853	0 51	0 73	0 75	0 87	1 14	0 95	0 71	0 67	0 93	3 41
1844-1853 to 1854	2 93	3 18	2 79	4 40	4 49	3 40	3 96	2 50	2 98	9 8
1854 to 1855	10 64	9 80	10 20	8 20	14 17	8 60	5 99	8 89	7 41	8 90
1824-1833 to 1855	1 71	1 82	1 62	2 6	2 58	1 81	1 79	1 46	1 59	5 17

The greatest increase in price from 1854 to 1855 was in chicken and beef. Between the whole period, 1824 to 1855, it is still greatest in chicken, and then in pork, which was probably caused by the rise in potatoes, consequent on the potato disease. If provisions have become dearer there has been a reduction in the price of clothing and furniture. The workman is warmer and better clad, and his furniture, however modest, is of a better character than formerly. We must also remember, that numerous little comforts have come within the reach of the workman, to which his father and grandfather were strangers. For his assistance numerous alimentary societies have been formed in the great industrial centres. There are two ways of helping the poor, one by increasing the amount of his resources by direct charity, the other attains the same end by supplying the workman with food at wholesale prices. But the latter has this advantage over the former, that whilst the one is likely to lower the self-respect of the recipient of charity, the other being a self-supporting system, enlists in its cause the interest of the workman, and encourages him to renew exertions for the attainment of a still higher degree of material comfort. This is the system upon which most of these societies have been formed. The capital is obtained by the issue of shares. A society of this description has been established at St. Quintin, which sells on an average the following number of portions of food per annum:—

	Portions.
Beef ("bouilli")	74,309
Bread	73,194
Broth with meat ("bouillon gras")	51,102
French beans	47,813
Beer	31,853
Stew ("ragoût")	24,079
Soup ("potage maigre")	11,472
Total	313,822

In several towns, amongst which Grenoble may be cited in the first rank, the Alimentary Societies have no restaurant, or only give a secondary importance to the local consumption.

Their operations consist:—

1. In collecting during the summer the savings which are destined to provide for the necessities of the winter.
2. In turning them to the best account until they are required.
3. In making judicious purchases at the proper moment, and in large quantities.

The Society at Grenoble, founded by M. Frederick Tanlier, in 1851, distributed each day more than 3,000 rations. It has been imitated at Lyons, Marseilles, Bordeaux, Rouen, Lille, &c., but the success has not always been the same, as the Directors have not all displayed equal ability and judgment.

Several railway companies, having the same object in view, have formed large stores for the convenience of their workmen. Amongst the railway companies so distinguished may be mentioned the "Chemin de Fer de l'Ouest," and that of the "Midi."

All articles purchased at these stores are paid for with ready money; and the workmen seem to appreciate the advantages offered them, as they are thus enabled to obtain good and cheap wares without the assistance of charity; and, by being forced to pay ready money, they have no temptation to run into debt.

Clothing.

The French workman wears a blue linen blouse and trousers. The suit costs 10*s*., and one will last from one to two years. The only difference made in winter is to put on two extra shirts, a woollen one over a cotton. Cloth clothing is more expensive in France than in England; and as there is no occasion for an Englishman who has emigrated to the north of France to make any change, it rests with him to judge whether it would not be more economical for him to adopt the cheaper, but less durable dress of the country. In either case, he will probably find that clothing costs more in France than in England. In the south of France, however, an English workman ought certainly to adopt the blouse, which is infinitely cooler and pleasanter than his own dress when there is great heat.

The following prices are those at present charged by a firm in Paris, whose principal dealings are with the working-class:—

Cheap.	F. c.		F. c.	£ s. d.		£ s. d.
Complete suit	25 0	to	52 0	1 0 0	to	2 1 7½
Paletôt	19 0		38 0	0 15 2½		1 10 4½
Coat	35 0		52 0	1 8 0		2 1 7½
Trousers and waistcoat	19 0		30 0	0 15 2½		1 4 0
Trousers	12 0		32 0	0 9 7½		1 5 7½
Great coat	25 0		39 0	1 0 0		1 11 2½
A coat						
A pair of trousers						
A waistcoat	The whole for 70 francs			. . .		2 16 0
A hat						
A shirt						
A pair of shoes						
A pair of gloves and a cravat						
Working Dress.						
Overalls	1 60	to	2 75	0 1 3½		0 2 2½
Blouses	1 90		4 25	0 1 6½		0 3 4½
Shirts, a-piece	2 25		5 50	0 1 9½		0 4 4½
Boots	4 0		15 0	0 3 2½		0 12 0

Health.

An Englishman may venture upon absolutely the same amount of exertion in the north of France as in England, but in the south he should be careful not to expose himself unnecessarily to the heat of the sun, and in some parts he should avoid remaining out at sunset. Great ameliorations have been latterly effected in the sanitary arrangements of the towns of France, but, as will be subsequently shown under the head of Lodgings, there is ample scope for further improvement. As, however, we cannot boast of perfection in our own sanitary arrangements, an Englishman emigrating to France would not, perhaps, find himself in a worse position as regards the preservation of health than he does at home.

Wherever he emigrates there is, however, one piece of practical advice which he should religiously follow. Let him watch the habits of the natives and act accordingly. Let him not presumptuously imagine that the constitution of an Englishman is such that he can afford to brave dangers to which the native succumbs. Let him not hastily put down to effeminacy or want of endurance habits and customs which are, in reality, but the result of experience and the knowledge of danger.

The following table shows the average length of life throughout France between the years 1806-61:—

Years.	Males.	Females.	Both Sexes.
	Yrs. mo.	Yrs. mo.	Yrs. mo.
1806-9	30 6	32 7	31 6
1810-14	30 7	33 3	31 10
1815-19	30 8	33 0	
1820-24	30 2	32 8	31 5
1825-29	31 5	33 11	32 8
1830-34	32 1	35 0	33 6
1835-39	33 5	36 4	34 11
1840-44	33 5	36 7	35 0
1845-49	34 4	37 7	36 0
1850-54	35 0	38 4	36 8
1855-59	33 8	37 2	35 5
1860	36 0	38 0	37 4
1861	33 4	36 4	34 10

The above figures show that the average length of life in France has increased within the last half-century about 5 years.

The death-rate of the French population between 1851 and 1856 was as follows:—

Years.	Population.	Death Rate of the French Population.	Rate of Deaths compared to Population.	Rate of Deaths per Cent.
1851	35,783,170	799,137	1 per 44·78	2·23
1852	36,004,085	810,737	1 per 44·40	2·25
1853	36,225,000	795,607	1 per 45·00	2·22
1854	35,910,496	992,779	1 per 36·00	2·77
1855	36,039,364	936,833	1 per 38·70	2·58
1856	36,039,064	835,917	1 per 43·16	2·30

As regards the proportion of deaths between the town and country population of France it will be seen that, taking the years 1853 and 1854, the rural population has a decided advantage:—

Populations.	Proportions of Deaths to Population.	
	1853.	1854.
	Per cent.	Per cent.
Department of the Seine	2·94	3·56
Town population	2·55	3·44
Country ditto	2·04	2·50
Average	2·21	2·77

The death-rate of England from 1845 to 1854 was 2·28 per cent. The first year in the above table may be taken as an average one as regards health, the second as an exceptional one, owing to the Crimean War and the cholera which raged throughout France during that year.

Lodgings.

Speaking generally, home comforts are not to be met with in the dwellings of the French workmen. Their houses in the small towns and in the country are mere lath and plaster erections, ill calculated to resist either the heat of the summer or the cold of winter. No doubt there are many exceptions to this rule, as in the case of the "Cités Ouvrières," which have been built in Paris, Marseilles, Amiens, and other towns. Many employers have also followed the good example thus set them, and have built as good houses for their workpeople as can be met with in the best parts of England. In large towns the artizans usually live in apartments in flats, which are apt to be overcrowded, and, as a rule, dirty. Workmen do not appear to have much difficulty in finding lodgings near their work; but this does not apply to Paris on account of the local separation of classes.

There is no system of drainage in any town of France equal to our own in London; nor is there that admirable water system so universally introduced not only into London but into all our large towns, by which the drains are kept clear from all accumulation of matter.

There exist, however, in most of the French towns very strict police regulations forbidding all refuse to be kept within doors for longer than twenty-four hours, and compelling each householder who does not possess a cesspool to bring out at night the accumulation of the day; it is then the duty of the public scavenger to remove it before morning.

The "Cités Ouvrières" already mentioned, are not all built on the same plan. Some are large barracks under regulation, in which apart-

ments are let out at a cheap rate to the working classes. Although these buildings have been erected with every regard for the comfort of the working man, and the regulations are made as little oppressive as is compatible with the order and regularity which are essential for individual happiness where large masses of men are brought together under the same roof, still they have never been popular amongst the classes for whose benefit they were erected. The French workman objects to supervision. On his return home he wishes to be a free man, and to be master of his own household; and the consequence is that, for lack of a sufficient number of working-men applicants, many of the apartments in these buildings are let to a class for whom they were never intended. The "Cité Ouvrière at Marseilles may be taken as a specimen of this class of building. It is built on the side of the well-known hill which overlooks Marseilles, and which is surmounted by the little chapel consecrated to Nôtre Dame de la Garde. It consists of a single building of three stories, and contains 150 rooms opening on to long corridors. The rooms are let for 4 fr., 5 fr., and 6 fr. a month. The furniture consists of an iron bedstead, a table, two chairs, a cupboard, and a looking-glass. Only men are admitted. The workmen have the use of a large restaurant in the house at very moderate prices. A physician attends and gives medicine gratis. Hot baths are prepared every Sunday, and cost 25 *c.*

The "Cité Ouvrière" in Paris, in the Rue Rochechouart, contains 170 dwellings, besides a *salle d'asile* and a small establishment of baths. Furniture is not provided. The rooms are better than can be obtained by workmen in the neighbourhood, and the price about the same. The Cité Napoléon was the first "Cité Ouvrière" erected in Paris, and is composed of 15 houses, 929 dwellings for married workmen, and 604 rooms for bachelors. Rent for workmen, 67 fr. to 250 fr. a year (2*l.* 13*s.* 7½*d.* to 10*l.*); for employés or clerks, 295 fr to 395 fr. (11*l.* 16*s.* to 15*l.* 16*s*). The furnished rooms are let for 8 fr. a month (6*s* 4¾*d*). At Amiens similar erections have been made. Rent for family, 78 fr. to 126 fr. (3*l.* 2*s.* 4¾*d.* to 5*l.* 0*s.* 9½*d*).

The system which has really been a perfect success is that adopted at Mulhouse, which town, since its annexation to Germany, does not fall within the scope of this Report. As, however, the whole history of the Cité Ouvrière at Mulhouse is connected with France, and a like system will probably be adopted in the erection of similar buildings in other towns of France, it may be interesting to explain the cause of the success with which this undertaking has been attended. The reason is obvious. The workmen's dwellings consist of rows of two-storied houses, each with a garden attached, and the condition of the lease is such that a workman, after a certain number of years, can obtain the freehold of his house. This has an immense moral influence on the population. There is no irritating system of supervision. The workman feels that he is the possessor of a real home, that in a few years he will become a proprietor, and thus the whole character of the man is changed. His self-respect increases, he feels himself a member of the body politic, and his interests enlist him on the side of order. In proof of this I will relate the following anecdote which occurred in real life.

A rich manufacturer in Rubaix had in his employ a most intelligent and able stoker, but unfortunately the man was a great drunkard.

One day as he was leaving the public-house the man fell down and broke his leg. Whilst he was laid up his employer visited him, and found him very anxious for the future of his family, as he had never saved money in his life. His master soon satisfied him on that head by telling him that he would still receive his wages although unable to work, and that he might pay him back by instalments as soon as he was able to resume work.

As he was confined to his bed for a long time, it was a whole year before the stoker was able to repay to his employer the money which he had advanced him during his illness. At the end of the year his employer suggested the advisability of economizing for the future as he had done in the past, and, to encourage him, told him that two years' savings at the same rate would realize the sum of 1,200 francs; the value of the house in which he was living, and which might then become his own property. The workman consented. He gave up drinking. The two years quickly passed, and the day after he had entered into possession of his newly-acquired property, the clerk of the works paid him his full wages. This time, however, he refused to receive them, adding that he intended to become the possessor of other houses in the row, and such was indeed the fact, for he is now the proprietor of three houses. So great is the power exercised by the love of property.

There are two sides, however, to every question, and we have as yet seen but the bright side.

The following passages are extracted from a Sanitary Report on the condition of Lille, which was drawn up and presented to the Municipality of that town in 1832. Great improvements have been effected since that date, and several new quarters for the working classes have been created, but if the misery is less now than in 1832 there is still enough left to afford ample scope for improvement.

"It is impossible to imagine the dwellings of our working classes without seeing them. Through the state of indifference and demoralization in which they live, they bring themselves into a condition of dreadful and deadly misery. In their dark, underground dens, in their rooms, which might be taken for cellars, the atmosphere, however loathsome, is never changed. The walls are covered with filth. The beds, when there are any, consist of dirty planks covered with damp and putrid straw. The coarse sheet, the colour and material of which are hidden under a layer of dirt, resembles a sieve in texture.

"The furniture is mildewed, bedaubed, and broken. The windows, always closed, are pasted up with paper so blackened and smoked that the light is unable to penetrate. In some cases the windows are nailed up by the proprietor to prevent the panes of glass from being broken by opening. The floor is worse than all, strewed with rubbish, filth, cinders, and remnants of vegetables picked up in the streets, and infested with vermin of all kinds. The air is unfit to be breathed," &c.

M. Blanqui has thus described the workman's habitations at Rouen. "The entrance is often by a low, dark, and narrow passage, where a man can hardly stand upright. These passages are the bed of a fetid stream issuing from the different stories and apartments, and which runs into the small courtyard and there stagnates. The staircases are spiral, without light or bannisters, bristling with hardened filth, and by them are reached dismal low dens, with windows and doors which scarcely open or shut, and with little or no furniture. The youngest children sleep on a bag of cinders; the rest of the family, father and mother, brothers and sisters, are all huddled together on a miserable litter.

Great efforts have been made to ameliorate the condition of these wretched classes, and much has been effected since the above lines were written, but the amount of poverty in existence renders it difficult to keep pace with it.

M. Jules Simon remarks, in speaking of the wretched condition of the working classes in the French towns, that luckily they are not aware of the extent of their misery, and in proof of this he quotes an old woman lying on some wretched straw in a damp cellar, who, pointing to her neighbour on the wet, bare floor, said, "Je ne suis pas riche moi, mais j'ai ma botte de paille, Dieu merci."

Whilst contemplating the misery of certain classes in the large French towns, we must not forget that our own metropolis, and many of our manufacturing towns, can show scenes of destitution as sad, and even worse; we must also remember that these are exceptional cases, and that the higher the civilization of a country the more marked is the difference between rich and poor.

Wages and Quality of Work.

There can be no doubt that the trustworthiness of the workman has an influence in most trades on his rate of wages. Of course in some mechanical employments, where the workman is but a machine, and where there is no scope for the quality of honesty or dishonesty to make its influence apparent, the former may not be remunerated as it should be, but, on the other hand, in some trades, such as the jeweller's, honesty fetches a high price. The persistent abstraction of an infinitesimal portion of the silk given to the Lyons workmen to manufacture has always weighed heavily on the trade of that city. The workman forgets that the effect of this petty fraud is to increase the cost of production—1st, by loss of material; 2ndly, by increased expenditure in supervision. He forgets that the manufacturer has to contend with competition, that his competitors are foreigners, who perhaps are not so heavily weighted in the race, working probably under more favourable circumstances, and where a stricter code of morals prevails. On this subject M. P. Beaulieu, in his "Populations Ouvrières," says:—"The manufacturer who is the victim of petty larceny is obliged to sell his goods at the same rate as foreign manufacturers, although the cost of production is greater in his case, owing to the frauds to which he is subject. To meet this he has but one resource, viz., the diminution of the rate of wages. Either the factory or workshop must be closed, or wages must be lowered. There is no middle course, and in either case the workman is the sufferer."

But the most distressing result of this is that the honest workman suffers likewise. This is the great injustice which all workmen should bear in mind. They should look on the petty thief as the public enemy, as one who not only robs his employer, but also his comrades. It might, indeed, be possible to understand such robbery if only the thief obtained a real advantage by this miserable system of pilfering, but the material he abstracts he cannot sell in the open market, and he is forced to be satisfied with a third or even a fourth of its value. It is extremely doubtful whether this illegal profit compensates him for the diminution of wages. Everything, says M. Augustine Cochin, is lowered when the master cheats the workman, the workman the master, or the middleman both. Loyal action in the matter of wages, and faithful service, have a very close connection. General improvement is the only means of raising wages and maintaining of the present superiority of industry.

There are certain professions in which the honesty of the workman is of special importance, and in which the slightest breach of faith would ruin not only himself but the entire industry. For instance, amongst workers in precious stones, where their labour sometimes occupies them for fifteen or twenty consecutive days at their own homes, all the precautions taken in the interest of the employers to ascertain the quantities and value given would be insufficient if it were not for the honesty of the workmen. A breach of trust amongst the stone-workers of Septmoncel would be sufficient to cause the banishment of this rich industry from the mountains of the Jura to the workshops of Paris and Amsterdam.

There can be no doubt also that skill or particular aptitude for certain branches of labour, exercise an important influence on the wages of the workman; witness the large sums that are paid in all trades to experienced, clever workmen, even though their moral character may be none of the best. But of this we may be sure, that the man who is possessed of both skill and honesty combined will always command the highest wages which the state of the market will allow the manufacturer to pay.

In 1856 the French Government, alive to the economical consequences of the dearth of 1853, instituted inquiries on the influence which the increased price of food had exercised on the rate of wages, with the following results:

RATE of Wages in the principal Departmental Towns (Paris excepted), during the years 1853 and 1857.

DAILY WAGE of a Working Man.

WHEN BOARDED.

	Ordinary Pay.		Maximum Pay.		Minimum Pay.	
	1853.	1857.	1853.	1857.	1853.	1857.
	F. *c.*	*F.* *c.*	*F.* *c.*	*F.* *c.*	*F.* *c.*	*F.* *c.*
	0 96	1 8	1 23	1 40	0 74	0 85
	F. *c.*		*F.* *c.*		*F.* *c.*	
Increase	0 12		0 17		0 11	

WHEN NOT BOARDED.

	Ordinary Pay.		Maximum Pay.		Minimum Pay.	
	1853.	1857.	1853.	1857.	1853.	1857.
	F. *c.*	*F.* *c*	*F.* *c.*	*F.* *c.*	*F.* *c.*	*F.* *c.*
	1 89	2 14	2 36	2 71	1 53	1 75
	F. *c.*		*F.* *c.*		*F.* *c.*	
Increase	0 25		0 35		0 22	

From the above table it would appear that wages, taken *en gros*, increased between 1853—1857 at the rate of about 14 per cent., or one-seventh.

But the most important point to ascertain is the ordinary daily rate of wage of workmen, not boarded, who compose by far the largest portion of working men, and form the real labouring class. Under this category it was found that ornamental workers in stone attained to the highest rate of wages—3 *fr.* 42 *c.* (2*s.* 9*d.*) in 1853, and 3 *fr.* 99 *c.* (3*s.* 2⅝*d.*) in 1857. Some of the more experienced workmen in the same profession received even as much as 4 *fr.* 70 *c.* (3*s.* 9⅝*d.* in 1853, and 5 *fr.* 70 *c.* (4*s.* 6¼*d.*) in 1857. After them came the workers in jewellery and precious stones, who received 2 *fr.* 74 *c.* (2*s.* 2⅝*d.*) in 1853, and 2 *fr.* 95 *c.* (2*s.* 4*d.*) in 1857. The wig-makers received the lowest wages, 1 *fr.* 35 *c.* (1*s.* 1*d.*) in 1853; 1 *fr.* 65 *c.* 1*s.* 4*d.*) in 1857; and the weavers, 1 *fr.* 43 *c.* (1*s.* 2*d.*) in 1853, and 1 *fr.* 58 *c.* (1*s.* 3*d.*) in 1857.

Amongst women, the artificial flower-makers obtained the highest rate of wages. From 1 *fr.* 33 *c.* (1*s.* 1*d.*) their wages rose within the five years to 1 *fr.* 49 *c.* (1*s.* 2⅜*d.*) The worst paid were the slop-workers, 95 *c.* (9½*d.*) in 1853, and 1 *fr.* 25 *c.* (1*s.*) in 1857; the staymakers, the embroiderers, and the seamstresses, who received from 97 *c.* to 98 *c.* (9⅝*d.* to 9⅞*d.*) in 1853, and 1 *fr.* 11 *c.* (10½*d.*) to 1 *fr.* 15 *c.* (11*d.*) in 1857.

In 1854 and 1855 the following were the rates of wages of workmen engaged in the house-building trade in the principal Departmental towns:—

AVERAGE Daily Rate of Wages obtained by a good Workman in the Building Trade.

	Fr. *c.*
Mason—	
1854	2 17
1855	2 24
Carpenter—	
1854	2 30
1855	2 38
Joiner—	
1854	2 32
1855	2 39
Locksmith—	
1854	2 38
1855	2 45

The quality of the work executed by French workmen is, as a general rule, good. They have much more taste than our own; they consequently excel in the manufacture of all articles of luxury, where refinement and a correct eye for the artistic is necessary; but where solidity or accurate finish are required, especially in iron and steel work, the Englishman is superior.

In answer to the questions whether the French artizans take a pride in their work, and put their character into it, and whether there is any class of artizans whose work can be depended upon as good from the sense of honour they have in executing it, I shall leave the Author of "Le Sublime, ou le Travailleur comme il est en 1870 et ce qu'il peut être," and who professes to be, or to have been, himself an artizan, to reply in his own words, as follows:—"Nous affirmons qu'il n'y a pas d'autre motif d'émulation qui vaille celui du gain. Nous ne pouvons comprendre un ouvrier travaillant pour la gloire. Elles sont nombreuses les personnes vivant dans le travail, qui ne comprendront pas l'efficacité d'un pareil stimulant."[1]

Cotton.

The manufacture of cotton, which now occupies so prominent a position amongst the industries of the world was only introduced into France about the middle of the seventeenth century. In 1816 the French manufactories were employed on more than 12,000,000 kilogrammes per annum (11,810 tons).

[1] "We maintain that there is no motive of emulation which comes up to that of gain. We cannot understand a workman toiling for glory's sake. Numerous are the persons living by work who would not understand the efficacy of such a stimulant."

The following table will show, year by year, the amount of raw cotton imported into France from 1816 to 1858:—

Years.	*Kilos.*	*Years.*	*Kilos.*
1816	12,115,000	1838	51,259,000
1817	13,370,000	1839	40,534,000
1818	17,034,000	1840	52,942,000
1819	17,010,000	1841	55,870,000
1820	20,003,000	1842	57,327,000
1821	22,587,000	1843	60,000,000
1822	21,572,000	1844	58,892,000
1823	20,384,000	1845	60,758.000
1824	28,630,000	1846	64,227,000
1825	24,667,000	1847	45,522,000
1826	31,914,000	1848	44,909,142
1827	29,684,000	1849	64,164,486
1828	27,375,000	1850	59,484,195
1829	31,889,000	1851	59,484,195
1830	29,260,000	1852	72,068,951
1831	28,229,000	1853	75,091,258
1832	33,636,900	1854	71,593,995
1833	35,610,000	1855	76,136,315
1834	36,035,000	1856	84,230,673
1835	38,760,000	1857	73,061,953
1836	44,332,000	1858	79,556,639
1837	43,830,000		

The above amounts represent the following values:—

Years.	*Francs.*	*£.*
1827-1836	58,973,886	2,350,000
1837-1846	96,623,309	3,860,000
1847-1856	99,756,752	3,990,000
1847	67,200,290	2,790,000
1848	40,484,659	1,700,000
1849	83,698,031	3,300,000
1850	104,578,688	4,180,000
1851	91,669,400	3,266,000
1852	106,617,240	4,260,000
1853	125,303,743	5,000,000
1854	110,328,621	4,410,000
1855	121,121,770	4,840,000
1856	146,565,076	5,860,000
1857	148,357,242	5,930,000
1858	145,483,748	5,810,000

About 90 per cent. of the cotton is imported from the United States, and the remainder from Egypt and India.

The cotton industry in France has, from its very commencement, adopted as its *spécialité* the manufacture of fine texture, whilst England, on the other hand, has principally aimed at the production of coarse articles at a cheap rate. The French textures, in consequence of their fineness and elegance, have always sold for higher prices than the English, but the proportion between the two prices has always remained about the same; a proof that the French, in their own *spécialité*, have made as much progress as we have. Thus, the French prices were reduced 50 per cent. between 1826 and 1853, and from 1833 to 1853 the reduction was not in a lesser ratio, as it has been calculated that the 34,000,000 kilogrammes of cotton manufactured in 1834 cost nearly as much as the 64,000,000 kilogrammes produced in 1853.

The "Statistique Officielle de l'Industrie," published in 1852, gives the following information with regard to the manufacture of cotton:—

Description of Manufactures.	No. of Factories.	No. of Workpeople.	Day's Wages.	English Currency.
			Fr. *c.*	*s.* *d.*
Wadding	1	18	1 50	1 2½
Spinning-mill	566	63,064	1 96	1 7½
Thread, braid, &c.	4	180	2 30	1 11
Candle-wicks	2	135	2 25	1 10½
Textures, calicoes, treble-milled cotton, blankets, prints, shawls	1,409	136,876	1 64	1 4½
Hosiery	75	8,598	1 71	1 5½
Trimmings, braces	4	743	2 5	1 8
Tulle	19	10,777	2 9	1 8
Net	1	60	1 50	1 2½
Lace	1	400	0 50	0 4½
Embroidery	25	6,140	0 85	0 8
Bleachers, dressers, and stiffeners	177	3,859	2 0	1 8
Stamped goods	87	10,081	2 36	1 11
Lawn, cambric	23	3,888	2 95	2 5
Total	2,394	244,819		

The districts in which the cotton industry flourished to the greatest extent before the war are those of Normandy and Alsace. The factories of the Seine Inférieure produced a third of the whole amount of cotton manufactured in France before the late war, and now that Mulhouse, which was one of the great centres of this manufacture, has fallen into other hands, the Department of the Seine Inférieure can boast a still higher ratio of production as compared with the rest of France.

The average wages of cotton-spinners are from 1 *fr.* 50 *c.* to 2 *fr.* (1*s.* 2½*d.* to 1*s.* 7½*d.*); 2 *fr.* (1*s.* 7½*d.*) is paid for spinning two sides, and 1 *fr.* 50 *c.* (1*s.* 2⅜*d.*) for spinning one side.

The hours of work at Rouen formerly were from 6 A.M. to 7 P.M. They are now reduced from 6 A.M. to 6·15 P.M., and in some establishments from 6 A.M. to 5·15 P.M., but the employers state that they are afraid they will not be able permanently to adhere to this reduction on account of the loss which this diminution of labour entails.

The following shows the difference in the wages of the workers in cotton in 1860 and 1870.

Piece-work.—Average salaries per day of good workmen :—

	1860.	1870.
	s. d.	*s. d.*
Spinners	1 3½	1 7½
Weavers	2 4½	2 11½
Carders	1 4½	1 7½
Winders—		
Men or Women	1 0	1 7½
Children	0 7½	1 0
Average	1 4½	1 10½

This augmentation of wages is at the rate of 30 per cent. in 10 years.

The proportion between the men, women, and children from 12 to 16 years of age, employed in the cotton factories of France is 50 per cent. men, 25 per cent. women, and 25 per cent. children.

In some manufactories a good weaver employed at piece-work can gain as much as 4*s* 9½*d.* a-day, but this is an exception.

In the Vosges wages are a little lower than those already quoted, but the augmentation during the last 10 years has followed the same ratio.

Physical Subdivisions.

General Observations.

Having answered in a general manner as regards the whole of France the questions contained in Lord Clarendon's Circular, I shall now, in pursuance of the plan laid down at the commencement of this Report, and for the sake of greater accuracy, divide France into six divisions, and, after giving a description of their physical and agricultural character, shall proceed to consider, separately from an industrial point of view, the principal manufacturing towns situated within their limits.

The information which I have been able to obtain either personally or by application to the Presidents of the Chambers of Commerce shall be added; but I regret to say that in reply to circulars which were despatched by me to over one hundred of the principal towns of France, I have only received twelve replies giving any information whatever: ten have written to say that they are unable to answer the questions at issue, whilst about ninety, notwithstanding reminders, have altogether ignored my communication.

It is by considering the difference in the amount of taxation paid per head, that it is easiest to arrive at a fair calculation of the comparative affluence of these separate divisions, and the accompanying table will show them arranged in their relative order.

Divisions.	Population.	Public Receipts, 1867.	Per Hectare.[1]	Per Head.
		Francs.	*Fr. c.*	*Fr. c.*
North-west	10,018,119	689,670,882	85 0	74 0
North east	5,628,776	219,119,490	24 0	40 0
West	6,574,916	214,630,889	23 50	33 50
South-east	5,084,710	254,331,846	27 50	44 0
South-west	4,803,740	157,456,905	17 90	31 25
The Centre	4,282,385	105,842,208	12 50	25 0

According to statistical calculations in 1866, the 50,000,000 hectares in France, subject to taxation, were thus divided :—

	Hectares.
Natural pastures	5,000,000
Vineyards	2,000,000
Gardens and orchards	2,000,000
Arable lands	25,000,000
Woods	8,000,000
Lands and artificial pastures	8,000,000
Total	50,000,000

The 2,000,000 hectares of gardens and orchards were thus classed :—

	Hectares.
Gardens and kitchen gardens	500,000
Chestnut groves	550,000
Olives	100,000
Mulberry	50,000
Apples and fruit-gardens	200,000
Nursery-gardens, osier-beds, &c.	600,000
Total	2,000,000

The 25,000,000 of arable lands as follows :—

	Hectares.
Wheat	6,500,000
Meslin and rye	2,500,000
Barley, maize, buckwheat	2,500,000
Oats	3,000,000
Roots	1,500,000
Artificial meadows	2,500,000
Vegetables	500,000
Industrial cultures, including flax, tobacco, colza, hemp, madder, &c.	500,000
Fallow lands	5,500,000
Total	25,000,000

North-Western division.

This region is the richest of the whole six, and consists of the following fifteen departments:—

[1] A hectare is equivalent to 2½ acres English; more correctly, 2·47 acres.

Departments.	Receipts in 1857.	Population, 1866.
	Francs.	
Nord	87,770,535	1,392,041
Pas de Calais	35,754,135	749,777
Somme	22,184,274	572,640
Aisne	22,242,022	565,025
Oise	20,065,550	401,274
Seine (containing Paris)	246,625,699	2,150,916
Seine et Oise	30,105,459	533,727
Seine et Marne	18,963,320	354,490
Seine Inférieure	99,230,620	792,768
Calvados	25,014,152	474,909
Eure	18,836,330	394,467
Orne	13,506,063	414,618
Manche	20,283,406	573,899
Eure et Loir	13,587,537	290,753
Loiret	15,491,580	357,110
Total	689,670,882 Or about £27,600,000	10,018,324

Although this region does not embrace more than a sixth of the whole of France, it contains nearly a fourth of the population, or more than 10,000,000 souls out of 38,000,000.

Its superiority in regard to wealth is even more striking. The surest way of coming to a true conclusion in regard to the different parts of a country, is, as has been already said, to compare the amount produced by taxation. From the above table it will be seen that nearly 690,000,000 of francs or 27,600,000*l.* were paid into the Public Exchequer by this district out of the 1,641,000,000 raised throughout France, during the same year.

This district enjoys a climate very similar to our own. Rain and fogs prevail in winter, though perhaps not quite to the same extent as with us.

It is calculated that there are in this region about 137 rainy days in the year. It is here that an English artizan desirous of finding employment in France would be most likely to direct his steps; first, on account of proximity to England, secondly, on account of similarity of climate, and consequently of food and clothing, and thirdly, on account of the large number of manufacturing towns to be found in this part of the country. All textile industries, with the exception of that in pure silk, are here to be met with. There are also important iron-works and machine works, especially at Lille and Denain, but these industries cannot compare with those in wool, cotton, and flax, either as regards the number of hands they employ, or the amount of business transacted. The same may be said of two other industries of a special kind; the extraction of coal, and the manufacture of beetroot sugar.

With regard to the former it will be sufficient, in order to appreciate its importance, to name the mines of Anzin, in the Department of the Nord, to which may be added those which have been opened in the Pas de Calais, such as Lens, and which have already given marked results.

The first discovery of coal in the north was in the year 1720. It was fourteen years later, in 1734, that superior coal was discovered at Anzin. The number of workmen employed in these mines is from 10,000 to 12,000, the majority of whom work underground.

The second of these industries, that of beetroot sugar, has more of an agricultural than an industrial bearing. The manufacture of sugar is only in activity for a few months in the year. It begins in October and ends in March, the labourers returning to their agricultural pursuits during the rest of the year; and this period of activity is being restricted year by year, as it has been found that, after a certain time, the beetroot loses its saccharine properties. The distillers of alcohol from the same root remain in activity throughout the year, but they do not require a numerous staff. Wool is spun at Roubaix, Tourcoing, Sedan, Amiens, &c. It is woven into fulled and milled stuffs, fine and coarse, at Sedan, Abbeville, &c.; into light and unfulled materials of an infinite variety at Roubaix, at Cateau, Amiens, and also at St Quentin.

Lille and its environs, and Rouen, are the principal seats of the cotton industry.

Amiens.—An Englishman proceeding to Amiens would find healthy lodgings close to his work in most parts of the town, and his family need run no risks with regard to health. The quality of the work executed by the French workmen is very good. The Amiens mechanics are competent in their work, and equal to the English. They take a pride in it; and during the American war considerable quantities of yarn were exported to Dundee, and sold at the highest prices going at the time. During the winter, whilst the Prussians invested Amiens and prevented all intercourse with the other Departments of France, the Compagnie Anonyme of that town was forced to work only half time. The amount of work produced under the half-time system was more than half the amount of production of full time (twelve hours), which has induced them to diminish their hours of work to ten a day. They are, as yet, uncertain of the result.

WAGES in the Cotton Trade.

	Wages.		English.	
	Fr. c.		*s. d.*	*s. d.*
Hecklers	2 0	to 3 0	1 8	to 2 6
Preparers	1 50	2 0	1 3	1 8
Spinners	1 50	2 20	1 3	1 10
Reelers	1 50	2 50	1 3	2 9½
Doffers	0 60	2 25	0 6	1 1
Weavers	2 0	4 0	1 8	3 4
Mechanics	3 0	5 0	2 6	4 2
Foremen	4 0	12 0	3 2½	9 7½

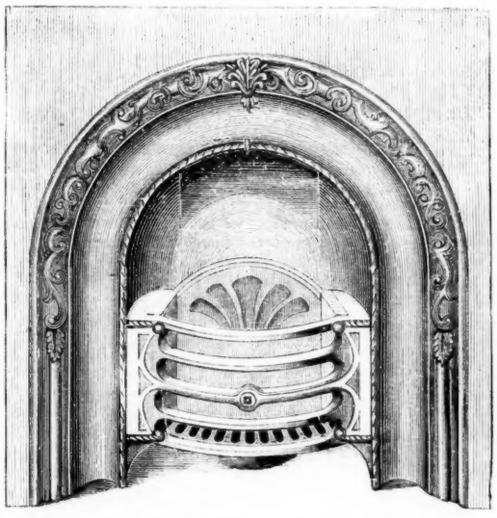
The houses built for their workpeople by the Compagnie Anonyme

consist of four rooms, with a coal-shed and a small garden. The rent, before the war, was 2 *fr.* 50 *c.* (2*s.*), which has now been reduced to 1 *fr.* 25 *c.* (1*s.*) The houses of the same class in the neighbourhood are let at from 2 *fr.* 50 *c.* to 2 *fr.* 75 *c.* (2*s.* to 2*s.* 2⅝*d.*) I shall here quote the words of a Scotch manufacturer who is the owner of a large jute manufactory at Ailly-sur-Somme, and who has been established in the neighbourhood of Amiens for the last thirty years. He says, "It is our opinion that wages, living, comfort, and everything concerning the working class in France are below England, and that English artizans coming out here would regret having left old England in many ways." He adds that the purchase power of money is about equal to that in England.

(*To be continued.*)

THE CARRINGTON ROTARY GRATE.

THE enormous cost of coal at the present time, and the extraordinary waste which has been allowed to occur, in its use for domestic purposes, have caused much attention to be devoted to the invention of some arrangement of fire-grate suitable for dwelling-houses, by which an economy in the consumption of fuel for heating and ventilation can be effected. With this view a patent has been taken out by Messrs. Carrington and Platt for a fire-grate of a novel yet simple construction,



designed to prevent the formation of smoke, and to cause more perfect and regular combustion of coal.

It consists of an ordinary fire-grate, with bars in front, and a back and sides of fireclay, the whole of which is pivoted or hung in a suitable frame on the supports, one in front and one behind the fire. By a small handle, this grate can be rotated on these pivots.

Small grates are placed both at the top and bottom, and are so arranged that while the one at the bottom is fixed, that at the top can be removed at pleasure, to allow of the introduction of fresh fuel.

The *modus operandi* is as follows:—The fire is lit in the ordinary manner, and when it has burnt clear the upper grate is removed, and a quantity of fresh fuel is placed on the fire, as in ordinary grates; the moveable grate is then replaced, and, by means of the small handle, the grate is turned round until the fresh fuel, which was placed at the top, now lies at the bottom, while the incandescent fuel previously at the bottom rests above it; thus the fire burns gradually downwards, all the ascending gases from the unburnt fuel being consumed by the red-hot coal above, and the production of smoke is almost, if not entirely, prevented.

When the fire requires replenishing, more fuel is added to the top, as before described, and the grate is again rotated. By making the capacity of the firegrate sufficiently large such replenishment is required but seldom, even at intervals as great as six hours.

The advantages claimed for this invention are a great economy of fuel, by the prevention of smoke and more perfect combustion, as well as a steady continuous fire, without attention for the addition of fuel or stirring with a poker. A grate of this kind should be valuable for use in offices, halls, bed-rooms, waiting-rooms, &c.

An experimental grate on the principle is now in daily use at the offices of Messrs. Beal and Fox, 21, Gresham Street, Old Jewry, E.C.

It is asserted that after a short trial, it has been found to save more than 20 per cent. of the fuel previously burnt in the fire-grate it has replaced, and to require neither attention nor addition of coal from 10 a.m. to 5 p.m. There are many modifications of the principle for various purposes.

From its simplicity it is well adapted to stand rough usage, and the absence of expensive machinery enables it to be made at a price not much above the cost of ordinary fire-grates.

TRADE AND HANDICRAFT NEWSPAPERS IN LONDON.

IT is a fact not well known to the general public that almost every trade and handicraft in London has its journal or newspaper, devoted mainly to the interests, and intended chiefly for the perusals of members of the fraternity. The mutual want, of employers and employed, the assaults of interlopers outside the trade, the making and sale of the tools and materials of labour, the prices current and the state of trade, the possible effects of legislation and taxation, the struggles between chambers of commerce and trades' unions—all are matters that come within the scope of trade journals; and it may be safely asserted that we cannot know the peculiarities and inner workings of the several branches of industry without a glance at their papers—their literary organs.

Setting aside the provinces, where each great manufacturing district may be supposed to have some journal or other devoted to the staple industry of the place—cotton, wool, flax, coal, iron, cutlery, or what not—we shall find that in the metropolis alone such newspapers are numerous and very diversified.

Let us take the trades in any way connected with food and beverages. We find the "Food Journal," the "Milk Journal," the "Bakers' Record," the "Corn Trade Review," the "Grocer," the "Brewers' Journal," the "Licensed Victuallers' Gazette," the "Wine Trade Review," the "Tobacco" (and the "Anti-Tobacco") Review," and so forth. Some are weekly, some monthly; some as low as a penny, some as high as a shilling; and they range from humble 8vo. to unmistakable folio. One and all convey bits of information that would be quite new to the outer world, though tolerably familiar to the members of the craft. No matter into which we dip, something curious is sure to turn up. Here, for instance, is a number of the "Bakers' Record," devoted to the dough, yeast, loaf, roll, muffin, crumpet, and dinner-baking interest. We here learn that there is a Master Bakers' Trade Protection Society; and that organizations distinct from this are the Central Bakers' Agency, the Bakers' and Confectioners' Tea Association, the United English and German Co-operative Society, the Amalgamated Union of Operatives, the Central House of Call for German Operative Bakers, and the Senior Knights of the Wheatsheaf, the last-named (we may suppose) being a friendly society. Every want of every baker is here anticipated. Smoke-consuming bakers' ovens, "bright nuts" to burn in them, patent yeast, bakers' drysaltery, bakers' shops to let and the goodwill to sell, respectable young men in want of situations, as first hand, second hand, head foreman, pastry hands, and hands used to customers and barrow, respectable young persons as shopwomen, &c. The editor touches on all things affecting the trade, and also gives admission to a poet, who sings:

> "A fair day's work for a fair day's pay
> Is what journeymen bakers say;
> They must not only say, but do it;
> Let sleepy hands alone fall through it."

Of the trades concerned chiefly with dress and personal adornment, we find a multitude of bits of information in "St. Crispin," a journal devoted to the interests of boot and shoemakers; "Sartor," the "Tailor and Cutter," the "Cutters' Monthly Journal," the "Tanners' and Curriers' Journal," the "Draper," the "Warehouseman and Draper," the "Milliner and Dressmaker," the "Hairdressers' Chronicle." the "Leather Trades' Circular," and the like. "St. Crispin" is a curiosity, and a very creditable one. It is a neat three-halfpenny quarto, full to the margin with information which appeals to the sons of St. Crispin. Editorial articles about the high price of leather; the artistic binding of the "opera-boot or stocking side-spring;" the "furring" of ladies

winter boots and shoes; the cutting-out of boots for mal-formed feet; and the supply of "boot-armour," a technical name for heel-plates, toe-plates, side-plates, and nails. A right suitable thing is a series of biographical notices of eminent shoemakers; this fraternity being notably rich in the names of men who deserve to be remembered. Then, turning over the pages of a number or two, we find advertisers telling the sons of St. Crispin where they can be served on the most advantageous terms with leather, shoe-mercery, closed uppers, elastic webs, boot-makers' sewing-machines, porpoise-skin leather, woven address boot-labels, boot and shoe laces and rosettes, boot-trees and shoe-lasts, quilted soles and shoe-tips, and guide-books for cutting out and making up. The technicalities of men wanting masters and masters wanting men almost require a dictionary for an outsider to understand them—clicker, woman's man, man's man, "a seat of work for good women's," "a good seat of repairing." An employer wants the services of "a light man's man and a strong woman's man," while another wants "a paste-fitter, used to bespoke work." There is a bit of pluck in the editor worthy of commendation. He is determined to report the police cases in which sons of St. Crispin have misconducted themselves, in order that they may be shamed into good behaviour; they sometimes menace him for so doing; but he is firm as a rock, and editorially declares that "no past threat has ever robbed us of an appetite or a wink of sleep."

The "Tailor and Cutter" is another good example of the trade-newspapers relating to the clothing handicrafts. We get an insight into "piece-work," in a letter sent to the editor. The hands are paid, in a provincial town, so much for making a boy's garment, so much for a youth's, so much for a man's; but then, there are fat boys and lean boys, tall boys and short boys; and hence sometimes arises the pertinent question (which Lord Lytton's Mr. Caxton once asked), "What is a boy?" The editor fills the part of arbitrator very equitably. He recommends an abandonment of estimate by age, and gives a rule for multiplying breast-measure by height, whether a boy is a boy or not. The journal contains notices of the "City of London Society of Practical Tailors," and the "Amalgamated Society of Tailors." The first of these is a creditable affair: a medium for the interchange of opinions concerning the most scientific modes of cutting out. Then there is a series of lessons by a Belgian tailor, on the whole art of cutting, illustrated by diagrams which beat Euclid in complexity. Of course, there are applications from men wanting masters, and *vice versâ*; and there are advertisements about paper patterns of garments, trimmings and mercery, graduated tapes, gold and silver lace for uniforms and liveries, tailors' utensils and sewing-machines, tailors' irons, and stoves for heating them, buttons and needles, coat-hangers and labels, and American shears "guaranteed to keep their temper and cut to the point."

If we wanted another example of this class, we might easily find it in the "Draper," a weekly journal crammed full of information interesting to drapers, hosiers, mercers, haberdashers, milliners, warehousemen, and all concerned in the preparation and sale of women's attire and the materials for it. The state of the cotton market, the state of the silk and woollen markets, industrial exhibitions, chambers of commerce, patented inventions relating to sewing machines and glove-buttons, shop fittings and show cases for drapers, new designs for mantles and skirts, drapers' stands and milliners' "busts," all come in for their due share of attention. The advertisements from employés wanting employers betoken a wide range and a minute classification—salesmen, window-dressers, lace buyers, glove and other buyers, stock keepers, shop walkers, second assistants, first and second-hand dressmakers, mantle saleswomen, mantle machinists, improvers, boys' clothing cutters, body hands, skirt hands, and so forth.

Beyond the two great groups of trades, those which relate to food and beverages, and to dress and adornment, there are ranges very wide and not easily classified, every one of which has its "organ" or trade newspaper. The "Builder," the "Building News," the "Builders' Weekly Reporter," the "Printers' Register," the "Bookseller" (the spirited and careful organ of the publishing trade), the "Stationer and Fancy Trades' Register," the "Chemist and Druggist," the "Horological Journal," the "Furniture Gazette," the "Ironmonger," the "Iron and Coal Trade Review," the "Oil Trade Review," the "Pawnbrokers' Gazette," &c., &c. One and all of these journals are replete with curious information, which we should be sorely puzzled to find elsewhere. The "Builders' Weekly Reporter" tells the fraternity all about new projects likely to benefit the trade—restorations and readornings, metropolitan improvements, the vagaries connected with the naming of streets, the best kinds of concrete and artificial stone, and steam joining factories in which machines rapidly fashion the interior wood-work for churches and houses. The "Printers' Register," one among three or four, deals with those matters which directly concern printers' machinists, pressmen, type founders, compositors, stereotypers, ink-makers, and the rest of the industrious hive. Advertisements are abundant from the makers of printing machines, apparatus, and materials, including those for bookbinders and account-book makers. Printers' gossip is collected from every corner of the world; and we cannot resist the temptation of quoting an exquisite bit from one number. It is an extract from an Australian newspaper, to the effect that "Owing to an unfortunate accident, caused by a horse breaking into our back premises, we were unable to print our first and last pages this morning." In the same number, in his notices to correspondents, the editor significantly advises printers to "weigh every ream of paper, cask of ink, and fount of type. We," he adds, "could tell some startling tales within our own experience." One would hardly expect a sale for a "Furniture Gazette;" yet there is such a paper, published weekly, and devoted to the interests of cabinet-makers, upholsterers, and the like. It is a remarkable trade, this, in the metropolis. The cheaper goods—by far the larger portion of the whole—are made by the workmen at their own homes, or at least in small workshops; and there are dealers, chiefly in the neighbourhood of Old Street Road, who sell all the materials for this kind of work in the smallest quantities required by the working buyers.

We might extend this notice of trade newspapers to any length; but enough has been said to show that the world of journalism and newspapers is wider and more varied than most of us are in the habit of supposing.

DESK IN CHESTNUT-WOOD.

DESIGNED BY OPPLER, ARCHITECT, OF HANOVER.

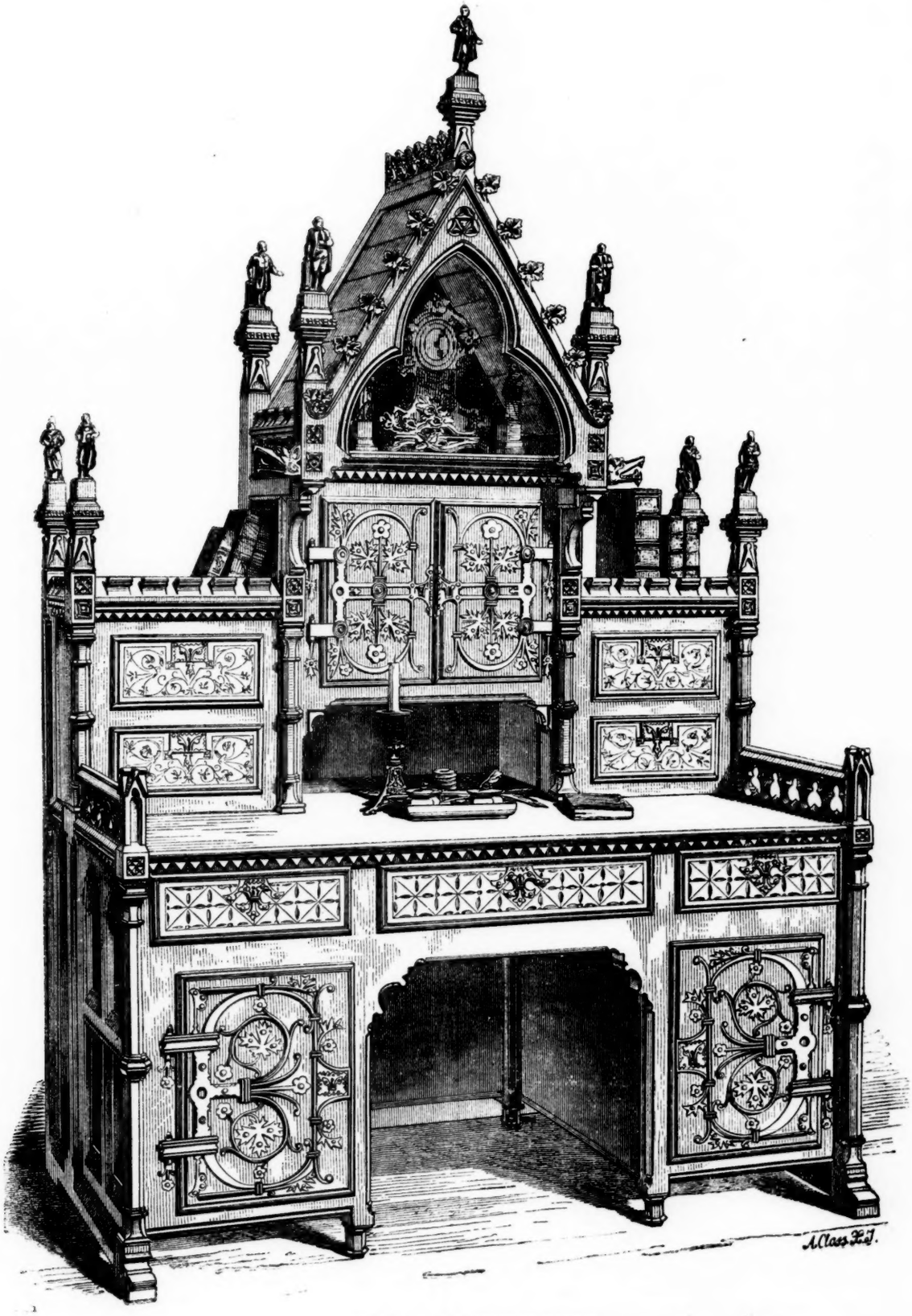
THIS desk was executed by Ahrens, carpenter, of Hanover. The corners are of wrought iron, polished, and in the form of the letter E, the initials of the lady for whom it was designed.

The ornaments of the doors are engraved, the rest being executed in relief.

The figures which crown the work are Albert Dürer, Peter Vischer, &c. They were made at Nuremberg. The cost of the desk, exclusive of the figures, was £24.

FISH CULTURE IN THE UNITED STATES.

PROFESSOR BAIRD, United States' Commissioner of Fish and Fisheries, gives, in his Report on 1872, an interesting account of the progress made in that year in stocking American rivers and lakes with shad, salmon, and other useful food fishes. He proposes to introduce the salmon and the shad into the great Salt Lake of Utah. "In this lake," he says, "there is a body of salt water, according to Stansbury, of 291 miles in circumference, exclusive of offsets, and abounding in low forms of crustaceæ and in dipterous larvæ to an unheard-of extent, admirably fitted for feeding myriads of any fish that can live in it. That the purely fresh-water species of trout and cyprinidæ are unable to survive therein is not to be wondered at; but there seems no good reason to suppose that salmon, shad, and alewives may not find a perfectly fitting resting-place, and one where they would in time multiply to an extraordinary degree, in consequence of the entire absence of the predaceous fishes, such as sharks, blue-fish, &c., which tend to keep down their numbers in the ocean. The experiment is worth trying, at any rate, and if successful it will add immeasurably to the food resources of the central portion of the West." The Commissioner is of opinion that the great Danube salmon, which sometimes reaches the weight of 100lbs., would find a perfectly suitable residence in the Mississippi river and its tributaries, feeding on the worthless chubs, suckers, and cat-fish so abundant there. The alewife can be propagated to a much greater extent than at present. The sterlet, a kind of small sturgeon, found in the Volga, and in Russia esteemed far beyond the turbot, will thrive in the Mississippi valley and in the lakes. The gourami, an East Indian fish, can be placed to great advantage in the milldams, ponds, &c., of the south, thriving as it does in very warm water, and feeding entirely on vegetable matter. It attains a weight of 20lbs., or more, grows with great rapidity, and is unsurpassed in the excellence of its flesh. These are mentioned as instances showing the opportunity there is of increasing to an almost unlimited extent the food resources of the country, and rendering the productiveness of the water superior, acre for acre, to that of land.



DESK IN CHESTNUT-WOOD.

Designed by Oppler, Architect, of Hanover.

ON TWO RECENT IMPROVEMENTS IN THE MANUFACTURE OF CHLORINE.

IN 1784 the great French chemist Berthollet made the first experiments in bleaching with chlorine, and soon after an Aberdeen, and simultaneously a Glasgow firm of linen manufacturers, tried it on a large scale. Since those days the application, and consequently the production, of chlorine has grown to an enormous extent. Not less than 75,000 tons of bleaching powder and the like amount of potash chlorate have, in 1871, been manufactured in the United Kingdom alone. No wonder, then, that this branch of chemical industry has been the object of many an attempt to improve or cheapen it. Among the numerous processes brought forward during the last few years, two have acquired an undoubted notoriety in this country as well as abroad. The one, Mr. Weldon's regenerating process, found soon adoption by trading manufacturers, and its application is daily spreading. The other, Mr. Deacon's catalytic process, though as yet less successful from a commercial point of view, possesses theoretically a very high interest.

Deacon's method is based on the well-known re-action that, when a mixture of hydrochloric acid gas and oxygen is sufficiently heated, water is formed and chlorine liberated. The utilization of this re-action for manufacturing chlorine on a large scale had already been tried by Oxland, but was attended by little success, most probably because at the same temperature at which hydrochloric acid is decomposed by oxygen, also the newly-formed water is decomposed by the chlorine. The specific discovery of Mr. Deacon is the above-named decomposition at much lower temperatures than had hitherto been tried, and he brings about this favourable condition by passing the hot mixed gases over a substance, which, though itself remaining unchanged, yet influences the change in the gases. The substance, possessing this property in a marked degree, is copper sulphate. All the compounds of copper have proved, however, active; but most become changed by oxidation or are converted into chlorides, whilst the sulphate comes out of the experiment unchanged. Pure sulphate of copper has been subjected to the action of hot hydrochloric acid and air for three or four weeks continuously, and gave only mere traces of cupric chloride at the end of the time. But this is true only below a certain temperature; if the heat be too high, the sulphate is readily converted into chloride.

A large number of experiments have proved that all that is necessary is to dip pieces of common red brick into a saturated solution of sulphate of copper, and dry them. With these charged pieces tubes are filled, and the heated gases (hydrochloric acid gas and oxygen) are passed through the tubes.

After having determined the most suitable active or catalytic substance, Mr. Deacon[1] turned his attention to various other points which have a bearing upon the course of the re-action, especially as to which temperature was the most favourable, what velocity the gases passing through the tubes ought to have, and in what proportions hydrochloric acid and air (or oxygen) should be mixed.

As to temperature, it was found that the re-action ensued most energetically at 370° to 400° C.; an increase of about 25° was found prejudicial, inasmuch as cupric chloride commenced to volatilize. 385° appears to be the best. It is noteworthy, that when experimenting on a small scale in the laboratory the most favourable temperature shows itself higher, usually 55° to 85° C. The cause is not known, but it is thought to arise in part from the fact that the re-action evolves heat, which in the small scale is quickly dissipated, but in the large scale is retained in the mass, many feet thick, and gradually accumulating, raises the temperature to the right degree.

The speed of the current of gases and the composition of the mixture of gases have been widely varied. The speed can be reduced until the chlorine evolved is the whole the hydrochloric acid gas contains, or increased till the chlorine evolved forms but a small per-centage of the mass passing, yet the total weight of chlorine evolved from the same apparatus at the same temperature in the same time is constant. Of course, if the gases were mixed with others exerting a chemical influence, the results would be varied, but with such gases as vapour of water, nitrogen, carbonic acid, and sulphuric acid gases, there is no change in the law. In point of fact, the atmosphere has been the source of oxygen almost always employed, therefore nitrogen has been constantly present, and vapour of water is one of the substances formed by the re-action, and must, therefore, always be present. Whilst the weight of chlorine remains constant, the per-centage of work done will necessarily vary with the quantity of hydrochloric acid gas passed. If the current be so slow that the re-action is complete, then 100 per cent. hydrochloric acid gas will be decomposed; but if double the quantity of acid gas be passed in the same time, only one-half of it will be decomposed, or only 50 per cent. of its chlorine will be liberated, and similarly for other quantities.

This statement, first made at the Liverpool meeting of the British Association, has since been somewhat modified by Mr. Deacon, as remarked by him in a lecture to the Fellows of the Chemical Society in June last.

Having given an outline of the process, mainly from Mr. Deacon's own description, I come to the various objections which have been raised with regard to this novel method. Some of them have been anticipated by the inventor, and correspondingly met. It was said that the large bulk of nitrogen introduced with the atmospheric air, and consequently mixed with the chlorine, would, in making bleaching powder, interfere with the saturation of the lime. But experience proved this fear to be groundless. Even with very moderate decomposition, and consequent large dilution of chlorine, good bleaching powder is easily made, simply by employing large surfaces of lime in series, the strong gases passing over the nearly saturated lime, and the spent gases over fresh lime.

The next apprehension that the apparatus would be too expensive was put aside by the fact that iron resists completely the action of chlorine in the decomposing tube.

That the heating has carefully to be regulated has already been stated. Mr. Deacon says that by using at his factory a regulator consisting of brickwork, he is able to maintain the temperature of the gas current for twenty-four hours within a variation of only 15° C., and without skilled attendance. It would be interesting to know the construction of this regulator, but it appears to be kept a secret.

The objection, that the increase in the bulk of the gas, resulting from admixture of nitrogen, will necessitate larger vessels than those now in use, is a feeble one; this could just as well be urged against the existing oil-of-vitriol works. It becomes, however, better founded when raised altogether with regard to the introduction of the new process, since this requires an almost entire change in the plant for the production of bleaching powder, the present arrangements being of very little use in the catalytic process.

A far greater obstacle to the adoption of Deacon's system is the great consumption of fuel. At the last meeting of German naturalists at Leipzig, it was asserted by Dr. Glaser, that to produce one ton of bleaching powder, two tons of coal are required. But this drawback need not necessarily continue to exist. It may, like many previous difficulties in this process, sooner or later be overcome. And should the catalytic method ultimately prove successful, as its inventor is sanguine that it will, two things will have been gained: lessening in manual labour, and saving of the large sums now paid to foreign countries for the peroxides of manganese.

R. G.

(To be continued.)

[1] Though the idea which underlies this ingenious process belongs solely to Mr. Deacon, he yet enjoyed, in successfully carrying it out, the valuable assistance of Dr. Hurter.

FUEL ECONOMISER.

OUR attention has been invited to a patent fuel economiser, the invention—if the scheme can fairly be called an invention—being, as it is, rather an improved mode of adapting the water tube-boiler principle or steam super-heater principle, to heating feed-water. At least a dozen plans of arranging pipes in up-takes to heat feed-water are in existence, but yet it is due to Mr. Twibill, of Manchester, to say that we believe he is the first to apply the system on the extensive basis he works on.

The scheme contains two features essentially distinct from each other, the one being the water-heater itself, the other the apparatus he employs for cleaning soot from the tubes. The heater consists simply of a collection of tubes set vertically in a brick-work casing, through which the products of combustion pass from the Cornish or other boilers to the stack. These tubes are carefully tested, after they are set in their place, to a pressure of 500 pounds per square inch. The feed-water for the boilers is either drawn or forced through the tubes; and the annexed table, which is an extract from a much larger one handed to us, will serve to show the gain effected by its use.

Time.	Monday. Degrees.	Tuesday. Degrees.	Wednesday. Degrees.	Thursday. Degrees.	Friday. Degrees.	Average Degrees.
6 a.m.	140	241	246	240	250	
9 „	272	272	278	284	312	273
12 noon	282	284	286	290	290	
4 p.m.	284	290	295	318	310	

It will be seen that the temperature at 6 on Monday morning is much lower than at any subsequent period of the week; this is, of course, owing to the cooling down of the apparatus during Sunday.

The second feature of the system is the peculiar tube scraper employed to clean the tubes. It consists of a ring, having its lower and upper edges chisel-shaped, and slightly helical; the ring itself is split, and has a slightly spiral spring action, which keeps the chisel-edges pressed to the tube-surface. The ring has two pairs of lugs or projections on it; and the bars used to lift the ring have wedge-shaped projections, which fit into the spaces between the lugs. It will be seen, from this description, that the ring rests on two wedges, and that if it be pressed with any force downwards, or if the wedges be forced up, that these wedges tend to press the top ring to the tube, and at the same time open the bottom ring, and ease it from the tube in the upward motion; while, on the other hand, if the wedges and ring are lowered, then the bottom ring embraces the tube closely in the downward motion, and removes all the soot, &c. The clearing-rings, and the bars for working them, are actuated by suitable mechanism placed above the economiser.

It gives us pleasure to notice this apparatus for saving fuel, and think it is a step in the right direction. We would, however, like to find out how far the saving in fuel compensates for the first cost and subsequent maintenance of the affair. Another point, too, we would like to learn is, whether a safety-valve is provided; we see none on the drawings before us, and every practical man well knows that a safety-valve is an essential on such an apparatus.

ON THE VALUATION OF SOLUTIONS FOR TECHNICAL PURPOSES BY MEANS OF THE HYDROMETER.

By C. R. A. WRIGHT, D. Sc., *Lecturer on Chemistry in St. Mary's Hospital Medical School.*

THE approximate determination of the strengths of aqueous solutions by means of a hydrometer being an operation of great frequency in many industrial processes, it is manifestly extremely desirable that the true relations between the specific gravity of a given solution at a given temperature, and the per-centage of dissolved matter contained in that solution, should be known with great accuracy. In practical manufacture, however, determinations of the strengths of solutions made by means of hydrometers are often subject to considerable errors from the following causes:—

(1.) The hydrometers manufactured and sold for technical purposes (other than the valuation of alcoholic liquors for the excise, &c.) are rarely graduated with such extreme accuracy as to exclude the possibility of errors of $\pm$ 0.005 in the specific gravity values estimated by such instruments; occasionally, especially in the case of instruments intended for liquids much heavier or lighter than water, much greater errors of gradation exist, but these are of comparatively rare occurrence, especially in instruments made by good makers. Errors from this source may be to a great extent avoided, where great accuracy is requisite, by determining by other means the exact specific gravities of fluids in which the hydrometer stands at known levels; the error at each part of the scale is then known, and a table can be constructed for the instrument once for all, so that the true specific gravity corresponding to each scale reading is known by reference to the tables: of course, a separate table is required for each instrument.

(2.) The relations between specific gravity and per-centage of dissolved matter which subsist in a given liquid are not uniform at all temperatures; that is, a solution containing a given per-centage of substance dissolved has a different specific gravity at each temperature, the density being usually less the higher the temperature; in order, therefore, to deduce the true strength of the solution, the experiment must be made at some fixed temperature—viz., that adopted in the standard experiments from which the table of strength used is calculated; or, what amounts to the same thing, a correction must be made (by means of a formula derived from careful experiments) in the value taken as the specific gravity, the extent of the correction depending on the difference between the actual temperature at which the observation is made and that to which the observation is reduced.

Thus it is found that sulphuric acid of specific gravity between 1·55 and 1·50 at 15° C. is lighter or heavier than that amount by 0·0082 for every degree centigrade that the temperature of observation is above or below 15° C. respectively; *i. e.* if acid have the specific gravity 1·500 at 15°, at 14° it will have the specific gravity 1·500 + 0·0082 = 1·5082; at 17° it will have the specific gravity 1·500 — 2 × 0·0082 = 1·4836; and generally, at t° it will have the specific gravity 1·500 — (t—15) × 0·0082.

(3.) The substances manufactured and used in industrial processes are rarely of perfect purity, and the presence of substances other than the particular body to be estimated in a solution causes an alteration (usually an increase) in the specific gravity of the solution, the alteration being proportionate to the amount and the kind of the impurities present. Except in special cases the amount of error thus introduced can rarely be allowed for, at any rate accurately; in some instances, however, by suitable devices the impurities may be eliminated, and the purified liquid can then be examined: thus sulphuric acid of specific gravity 1·8 can retain a considerable amount of lead sulphate in solution, whereas much more dilute acids only retain traces; if it be required to determine by means of the hydrometer the true value of a strong acid contaminated with sulphate of lead, the acid is mixed with once, twice, or more times its own weight of pure water; the sulphate of lead is rendered insoluble by the dilution and is precipitated; the clarified liquid (after cooling) is then examined by the hydrometer, and the indicated per-centage (corrected for temperature and errors of graduation) multiplied by 2, 3, 4, according as the weight of the original acid was doubled, trebled, or quadrupled by dilution.

British manufacturers usually employ a scale of specific gravity known as *Twaddell's*. The true specific gravity of a liquid is the ratio between the weight of a unit of volume of the liquid and that of a unit of volume of pure water, measured under the same circumstances; since water and other liquids rarely expand at the same rate, the specific gravity of a liquid varies with the temperature. Ordinarily, however, the specific gravity of a liquid is referred to as being the weight of a given volume of the liquid, that volume of water measured at the point of maximum density (4° C.) being unity. Hence, in the metrical system, the specific gravity of a liquid means the weight in grammes of one cubic centimetre of the liquid. When, therefore, the specific gravity of sulphuric acid is said to be 1·8, the meaning is, that one cubic centimetre of such acid weighs, under the particular circumstances that exist at the moment, 1·8 grammes. The Twaddell's scale is constructed from that of the true specific gravity, thus; 1 gramme is subtracted from the weight of a cubic centimetre of the body in question: the residue (positive or negative) is then multiplied by 200, and the product is said to be *the number of degrees Twaddell indicated by the substance.* Thus, sulphuric acid of specific gravity 1·8 is at (1·8 — 1) × 200 = 160 degrees Twaddell. Spirits of wine of specific gravity 0·9 is at (0·9 — 1) × 200 = — 20 degrees Twaddell. Hence the following rules, to convert Twaddell degrees into true specific gravity. *Multiply by* 5, *add on* 1,000, *and divide the whole by* 1,000; or, *divide by* 200 *and add* 1· *to the quotient.*

On the Continent, other scales are in use, the connection between which and the true specific gravity is less simple. The one most frequently used (that of *Beaumé*), is constructed thus: 10 parts of common salt are dissolved in 100 parts of water, the point to which the hydrometer sinks in this solution at 15° is called 10° Beaumé, water being 0°; the length of the hydrometer scale between 0° and 10° is then divided into 10 equal parts or degrees, and these degrees are continued upwards and downwards. The following table exhibits the relation between the Beaumé scale, the Twaddell scale, and the true specific gravity, the Beaumé scale being calculated from Gilpin's determination of the specific gravity of a 10 per cent. solution of common salt, viz.: 1·074626 at 12·5° centigrade. It is to be noticed that several other values for this specific gravity are assigned by other experimenters, and that consequently no little confusion exists as to the true value of Beaumé's scale.

Beaumé's scale (Gilpin).	True Specific Gravity.	Twaddell scale.
10	1·075	15·0
15	1·116	23.2
20	1·161	32·2
30	1·261	52·2
40	1·384	76·8
50	1·532	106·4
60	1·714	142·8
66	1·848	169·6

To illustrate the difference between the Beaumé scale as represented by different experimenters, the following table may be given:

Beaumé.	Delezennes. At 12·5° C.	Bohnenberger. 15° C.	Francœur. 12·5° C.	Gilpin. 12·5° C.	Schober and Packer. 17·5° C.	Graham's Chemistry.	Morozeau. 12·5° C.
10°	1·0769	1·069	1·0704	1·075	1·0740	1·073	1·075
15°	1·1200	1·107	1·1095	1·116	1·1152	1·113	1·116
20°	1·1666	1·148	1·1515	1·161	1·1598	1·157	1·161
30°	1·2727	1·239	1·2459	1·261	1·2605	1·256	1·263
40°	1·3999	1·347	1·3571	1·384	1·3804	1·375	1·384
50°	1·5555		1·4902	1·532	1·5255	1·515	1·530
60°	1·7501		1·6522	1·714	1·7047	1·690	1·711
66°	1·8922		1·7674	1·848	1·8340	1·815	1·842

The relations between the specific gravities of solutions of various kinds and the percentages of dissolved substances contained therein, have been studied by many experimenters, and tables containing the result of their observations are to be found in every work on technological chemistry; it rarely happens, however, that manufacturing operations require, or even admit of considerable precision in matters of this kind; thus in soap-boiling, the causticized leys are made of such strength as to possess a particular specific gravity suitable to the purpose intended; but the quantity of soda contained in such a solution can rarely be inferred from the specific gravity, the presence of considerable quantities of sodium chloride and sulphate in the liquors preventing the applicability of the hydrometer in such cases, at any rate as more than a rough guide. In the case of substances that can be distilled, however, the hydrometer is frequently a valuable guide in determining the purity of the substance, and in regulating the manufacture; thus in tar-distilling, it is usually more convenient to regulate the fractional distillation by the examination of the density of the distillate, than by noticing the boiling point; similarly in the manufacture of alkali, it is necessary to know the density, and hence the strength of the sulphuric acid used, in order to judge of the quantity to be employed for each batch of salt cake.

In order to facilitate the calculations of the British manufacturer, the following tables of the specific gravities of sulphuric and hydrochloric acids have been calculated by the author from the original experiments of the observers, so that the results are expressed directly in degrees Twaddell.

Sulphuric Acid.—(*Bineau: Annales de Chémie et Physique [iii.] xxiv.* 341.

Degrees Twaddell at 15° C.	Sp. gr. at 15° C.	Diminution in density for each 1° C. above 15° C. (in fractions of a degree Twaddell.)	Percentage of Sulphuric Acid (H_2SO_4)	Difference for each degree Twaddell.
168·52	1·8426	0·192	100·00	—
168	1·840	0·191	97·00	—
167	1·835	0·190	93·62	3·38
166	1·830	0·189	91·75	1·87
165	1·825	0·188	90·60	1·15
164	1·820	0·187	89·66	0·94
162	1·810	0·186	88·14	0·76
160	1·800	0·185	86·75	0·70
157	1·785	0·184	84·89	0·63
154	1·770	0·183	83·80	0·53
150	1·750	0·182	81·45	0·46
145	1·725	0·181	79·25	0·44
140	1·700	0·180	77·16	0·42
135	1·675	0·179	75·00	0·43
130	1·650	0·178	72·92	0·42
125	1·625	0·176	70·83	0·42
120	1·600	0·174	68·66	0·43
115	1·575	0·172	66·58	0·42
110	1·550	0·170	64·42	0·43
105	1·525	0·167	62·18	0·44
100	1·500	0·164	59·89	0·46
90	1·450	0·160	55·19	0·47
80	1·400	0·155	50·20	0·50
70	1·350	0·148	44·89	0·53
60	1·300	0·140	39·29	0·56
50	1·250	0·131	33·29	0·60
40	1·200	0·120	27·23	0·61
30	1·150	0·100	20·79	0·64
20	1·100	0·080	14·25	0·65
10	1·050	0·047	7·50	0·67

The following examples illustrate the use of this table. Suppose an acid to mark 154·5° Twaddell at 25° C. The "diminution in density for each 1° C. above 15°" is, for acid of about 155°, 0·183 degrees; hence at 15° the above acid would have a density of 154·5 + 10 × 0·183 = 156·3° Twaddell, and would therefore contain 84·52 per cent. of sulphuric acid (H_2SO_4):

For, acid of 154° would contain (as per table) 83·30 per cent.
Add on for 2·3°; 2·3 × 0·53 = 1·22 „ „

156·3 84·52

Suppose an acid containing lead sulphate to be diluted with twice its weight of water; after subsidence and cooling the dilute acid marks 30·8° at 8° C. The "diminution in density" at 30° is 0·100; hence acid of 30·8° at 8° would mark 30·8 — 7 × 0·100 = 30·1° at 15°.

Acid of 30° would contain 20·79 per cent.
Add on for 0·1°; 0·1 × 0·64 = 0·06 „ „

30·1 20·85

Hence the diluted acid contained 20·85 per cent. of sulphuric acid (H_2SO_4). As the original acid was increased to 3 times its original weight by the addition of water, the original percentage was 3 × 20·85 = 62·55.

Hydrochloric Acid.—*Kolb: Comptes Rendus, lxxiv.* 737.

Degrees Twaddell.	Sp. Gr.	Percentage of Anhydrous Acid. At 15°.	Percentage of Anhydrous Acid. At 0°.	Difference in percentage for 1° Centigrade.
1	1·005	1·0	1·0	
2	1·010	2·0	1·9	0·01
3	1·015	3·0	2·9	0·01
4	1·020	4·0	3·8	0·01
5	1·025	5·0	4·8	0·01
6	1·030	6·0	5·7	0·02
7	1·035	7·0	6·7	0·02
8	1·040	8·0	7·6	0·02
9	1·045	9·0	8·6	0·03
10	1·050	10·0	9·5	0·03
11	1·055	11·0	10·5	0·03
12	1·060	12·0	11·4	0·04
13	1·065	13·0	12·4	0·04
14	1·070	14·0	13·3	0·05
15	1·075	15·0	14·2	0·05
16	1·080	16·0	15·2	0·05
17	1·085	17·0	16·1	0·06
18	1·090	17·9	17·0	0·06
19	1·095	18·9	18·0	0·06
20	1·100	19·9	18·9	0·07
21	1·105	20·9	19·9	0·07
22	1·110	21·9	20·8	0·07
23	1·115	22·9	21·8	0·07
24	1·120	23·9	22·7	0·08
25	1·125	24·9	23·7	0·08
26	1·130	25·9	24·6	0·08
27	1·135	26·9	25·6	0·09
28	1·140	27·8	26·5	0·09
29	1·145	28·8	27·5	0·09
30	1·150	29·8	28·4	0·09
31	1·155	30·8	29·4	0·09
32	1·160	31·8	30·3	0·10
33	1·165	32·8	31·3	0·10
34	1·170	33·7	32·2	0·10
35	1·175	34·7	33·2	0·10
36	1·180	35·7	34·1	0·11
37	1·185	36·7	35·1	0·11
38	1·190	37·8	36·1	0·11
39	1·195	39·9	37·1	0·12
40	1·200	40·0	38·1	0·13
41	1·205	41·2	39·1	0·14
42	1·210	42·4	40·2	0·15

Thus, suppose it be required to find the percentage of anhydrous hydrochloric acid in a solution that marks 34·5° Twaddell at 10° centigrade.

Acid at 34° would contain at 15° C. 33·7 per cent.
„ 35 „ „ „ 34·7 „ „
Hence at 34·5 „ „ „ 34·2 „ „

For every degree centigrade below 15° the percentage diminishes by 0·10; hence at 10° the percentage will be 34·2 — 0·10 × 5 = 33·7.

Let it be required to find the percentage of acid in a solution that marks 40° at 18° C.

Acid at 40° at 15° C. would contain 40·0 per cent.
At 18° there must be added on 3 × 0·13 = 0·39.

40·39

Hence the solution contains 40·39 per cent. of anhydrous acid.

Where only a close approximation is required, *the degrees Twaddell marked by a hydrochloric acid solution at 15° C. may be taken as the percentage of anhydrous acid contained therein.*